

Automatic Level Control Description and Operation (w/F55)

General Description

The Automatic Level Control (ALC) system automatically adjusts the rear height of the vehicle in response to changes in vehicle loading.

The ALC system consists of the Electronic Suspension Control module, 2 position sensors, an air compressor assembly, an ALC compressor relay, an intake hose and filter, an air tube, and 2 rear shock absorbers. The air compressor assembly consists of an air compressor and an air dryer mounted on a bracket. The air compressor head is a replaceable part of the air compressor. The exhaust solenoid is a non-replaceable part of the air compressor head.

The vehicle's rear vertical height is measured by the 2 position sensors. These 2 position sensors convert this rear height measurement into an analog voltage which is read by the ESC module. The ESC module then determines what action exhaust, compress, or no action shall take place. To compress, the ESC module switches the ELC compressor relay to ground.

The compressor is activated when the ignition is on, and weight is added to the vehicle. The exhaust solenoid is connected directly to the battery (+), enabling the system to exhaust with the ignition on or off when excess weight is removed.

Raising the Vehicle

When a load is added to the vehicle, the vehicle body moves down causing the sensor actuating arm to rotate upward. The upward arm movement activates an internal timing circuit and, after an initial fixed delay, the ESC module provides a ground to complete the compressor relay circuit. The battery positive circuit to the compressor is then complete and the compressor runs, sending pressurized air to the shock absorbers through the air tubes.

As the shock absorbers inflate, the vehicle body moves upward rotating the actuating arm towards its original position. Once the body reaches its trim height, the compressor relay circuit is opened and the compressor is turned off.

Air Compressor Head Relief Sequence

In order to reduce current draw during air compressor starting, the ESC module performs an air compressor head relief sequence before air compressor operation. This sequence reduces the air pressure in the air compressor cylinder during start-up. The air compressor head relief sequence occurs as follows:

- Exhaust solenoid is activated.
- Air compressor is activated 1.3 seconds after the exhaust solenoid is activated.
- Exhaust solenoid is de-activated 0.5 seconds after the air compressor is activated.

Lowering the Vehicle

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When a load is removed from the rear of the vehicle, the body rises, causing the sensor actuating arm to rotate downward. This again activates the internal timing circuit. After the initial fixed delay, the ESC module provides a ground to complete the exhaust solenoid circuit, activating the solenoid. Now, air starts exhausting out of the shock absorbers, back through the air dryer and exhaust solenoid valve, and into the atmosphere.

As the vehicle body lowers, the actuating arm rotates to its original position. When the vehicle body reaches its trim height, the exhaust solenoid is deactivated, which closes the exhaust solenoid and prevents air from escaping.

Air Replenishment Cycle

An air replenishment cycle (ARC) is commanded after each ignition-ON cycle. The purpose of the ARC is to ensure that the ALC system is operating at or above minimum air pressure. The ARC occurs as follows:

- The EXHAUST SOLENOID IS ACTIVATED 20 seconds after the ignition has been turned on.
- The AIR COMPRESSOR IS ACTIVATED 1.3 seconds after the exhaust solenoid is energized.
- The EXHAUST SOLENOID IS DE-ACTIVATED 0.5 seconds after the air compressor is activated.
- The AIR COMPRESSOR IS DEACTIVATED 3.2 seconds after the exhaust solenoid is de-energized.

Air Compressor Description

The air compressor is a positive displacement air pump, powered by a 12 volt DC permanent-magnet motor. The air compressor head contains intake and exhaust ports plus a solenoid-operated exhaust valve that releases air from the ALC system when activated. Air compressor intake air is drawn through an intake air hose and filter, mounted in the body rail. The air compressor is a serviceable part and is mounted on a bracket. The bracket is mounted to the underbody behind the right rear wheel well.

Air Dryer Description

The air dryer is attached to the air compressor head assembly at the pressure outlet and provides a dual function:

- It contains a moisture-absorbing desiccant chemical that absorbs moisture from the compressed air before it is delivered to the rear struts. Moisture is removed from the air dryer and returned to the atmosphere when air is exhausted out of the struts during lowering.
- It contains valving that maintains a system residual pressure of 48 to 97 kPa (7 to 14 psi). This system pressure is maintained for improved ride characteristics and improved air sleeve reliability.

Exhaust Solenoid Description

The exhaust solenoid is a non-serviceable part of the air compressor head and provides a dual function:

- When activated, it exhausts air from the rear struts.
- It acts as a relief valve to limit the maximum air pressure output of the compressor.

Automatic Level Control Sensor Description

The 2 position sensors that are utilized by the ALC system are mounted on the body, one sensor over each upper control arm of the rear suspension. Each rear position sensor has a link that is connected to corresponding rear suspension upper control arm.

The ESC module provides supply voltage of 5 volts and ground to the position sensors. The position sensors then supply an analog output voltage of 0.35 to 4.75 volts back to the ESC control module. The amount of voltage is dictated by the vertical height of the rear of the vehicle.

Air Shock Absorber or Strut Description

The rear air adjustable shock absorbers are constructed with a rubber-like air sleeve attached to the dust tube and reservoir. This sleeve forms a flexible chamber which extends the shock absorber when pressure in the chamber is increased. When air pressure is reduced, the weight of the vehicle collapses the shock absorber. In order to maintain proper operation and reliability of the air adjustable shock absorbers, a system pressure from 48-97 kPa (7-14 psi) must be maintained at all times.

Air Lines and Connectors Description

The air tube is a non-serviceable item consisting of the following:

- One connector at the ALC air dryer
- Two tubes between the ALC air dryer and the 2 rear shock absorbers
- Two connectors with spring clips, 1 at each rear shock absorber

At the rear shock absorbers, the air tube connectors are held on with spring clips which snap into the grooves of the shock absorber air fittings. Air tube connectors are sealed using 2 O-rings.

Although the tubes are flexible, care should be taken not to kink them and to keep them from contacting the exhaust system.