

Component Procedures: Antilock Brakes / Traction Control Systems

Table of Contents

1. Parts and Labor (itype_189)
2. ABS Description and Operation (w/ F55) (Article 10526)
3. ABS Description and Operation (w/o F55) (Article 10527)
4. Antilock Brake System Schematics (Article 10582)
5. Anti-Lock Brakes (Article 11047)
6. Antilock Brake System - Fastener Specifications (Article 10584)
7. All New Technical Service Bulletins (itype_432)
8. All Technical Service Bulletins (itype_100)
9. Customer Interest Bulletins (itype_109)
10. Repair Tips (itype_110)
11. Electronic Brake Control Module Scan Tool Information (Article 10776)
12. Symptoms - Antilock Brake System (Article 10565)
13. ABS Indicator Malfunction (Article 10528)
14. Hill Start Assist Malfunction (Article 10564)
15. Traction Control/Stability Control Indicator Malfunction (w/ F55) (Article 10566)
16. Traction Control/Stability Control Indicator Malfunction (w/o F55) (Article 10568)
17. Antilock Brake System - Special Tools (Article 10583)
18. Noise (itype_156)

Component Procedures: Antilock Brakes / Traction Control Systems

Parts and Labor (itype_189)

Labor

Operation	Qualifier Path	Skill	Std Hrs	Wty Hrs
Remove & Replace	Anti-Lock Brakes > Control Module, R&R	B	0.7	0.5
Remove & Replace	Anti-Lock Brakes > Front Speed Sensor, R&R > ?	B	0.5	0.3
Remove & Replace	Anti-Lock Brakes > Modulator Valve, R&R	B	1.6	1.0
Remove & Replace	Anti-Lock Brakes > Rear Speed Sensor, R&R > O?	B	0.5	0.3
Remove & Replace	Anti-Lock Brakes > Yaw Rate Sensor, R&R	B	1.0	0.0
Remove & Replace	Traction Control > Switch, R&R	B	0.3	0.2

ABS Description and Operation (w/ F55) (Article 10526)

This vehicle is equipped with a Bosch ABS 8.0 brake system. The electronic brake control module and the brake pressure modulator are serviced separately. The brake pressure modulator uses a four circuit configuration to control hydraulic pressure to each wheel independently.

The following vehicle performance enhancement systems are provided.

- ABS
- Traction control
- Stability control
- Dynamic rear proportioning
- Hill start assist
- Hydraulic brake assist

The following components are involved in the operation of the above systems:

- Electronic brake control module – The electronic brake control module controls the system functions and detects failures. It supplies voltage to the solenoid valves and pump motor.
- Brake pressure modulator – The brake pressure modulator contains the following components:
 - Hydraulic pump with pump motor
 - Four isolation solenoid valves
 - Four dump solenoid valves
 - Two traction control/stability control prime solenoid valves
 - Two traction control/stability control isolation solenoid valves
 - Pressure sensor
 - High pressure accumulator
 - Low pressure accumulator
- Multi-axis acceleration sensor – The yaw rate and lateral acceleration sensors are combined into one multi-axis acceleration sensor module, external to the electronic brake control module. The electronic brake control module receives serial data message inputs from the yaw rate, longitudinal, and lateral acceleration sensor and activates stability control depending on multi-axis acceleration sensor module input.
- Steering wheel angle sensor – The steering wheel angle sensor receives ignition voltage from the electronic brake control module. The electronic brake control module receives serial data message inputs from the steering wheel angle sensor identifying the position and direction of the steering wheel rotation. It utilizes this signal to calculate the driver intended driving direction. The steering wheel angle signal is also used to calculate the desired yaw rate.
- Traction control switch – The traction control switch is a momentary contact switch. The traction control can be manually disabled or enabled by pressing the traction control switch once. When the traction control switch is pressed twice the performance traction mode is available. There are five modes adjustable by the driver for changing track conditions based on driver confidence and skill level. When the traction control switch is pressed and held for five seconds the stability control can be manually disabled.
- Tour mode switch – The tour mode switch is a momentary contact switch that has two positions, TOUR 1 and TOUR 2. The electronic brake control module sends a serial data message to the suspension control module to modify the shock damper rates which will change the ride and handling characteristics of the vehicle. The body control module reads the performance mode from the electronic brake control module and requests the instrument panel via serial data to display the selected competitive mode message on the driver information center.
- Sport mode switch – The sport mode switch is a resistor ladder switch that has three positions, SPORT 1, SPORT 2 and TRACK. The electronic brake control module sends serial data messages to the suspension control module to modify the shock damper rates which will change the ride and handling characteristics of the vehicle. The electronic brake control sends serial data messages to the engine control module to manage engine

torque based on the track conditions. The body control module reads the performance mode from the electronic brake control module and requests the instrument panel via serial data to display the selected competitive mode message on the driver information center.

- Wheel speed sensors – The wheel speeds are detected by active wheel speed sensors and encoder rings. The encoder rings consist of permanent magnets located in the hub. As the wheel spins the magnetic encoder ring rotates and passes by the wheel speed sensor head; which generates a sign wave in the wheel speed sensor. Each wheel speed sensor receives ignition voltage from the electronic brake control module and provides an alternating current square wave signal to the electronic brake control module. The electronic brake control module uses the frequency of the signals to calculate the wheel speeds.

Initialization Sequence

The initialization sequence cycles each solenoid valve and the pump motor, as well as the necessary relays, for approximately 30 milliseconds to check component operation. The electronic brake control module sets a DTC if any error is detected. The initialization sequence may be heard and felt while it is taking place, and is considered part of normal system operation. The self test is initiated by the electronic brake control module at the start of the ignition cycle and the speed of the fastest wheel exceeds 16 km/h (10 MPH).

ABS

When wheel slip is detected during a brake application, an ABS event occurs. During ABS braking, hydraulic pressure in the individual wheel circuits is controlled to prevent any wheel from slipping. A separate hydraulic line and specific solenoid valves are provided for each wheel. The ABS can decrease, hold, or increase hydraulic pressure to each wheel. The ABS does not, however, increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During ABS braking, a series of rapid pulsations is felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as the electronic brake control module responds to wheel speed sensor inputs and attempts to prevent wheel slip. These pedal pulsations are present only during ABS braking and stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves cycle rapidly. During ABS braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during ABS operation.

Vehicles equipped with ABS may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking is no different than that of previous non ABS systems. Maintaining a constant force on the brake pedal provides the shortest stopping distance while maintaining vehicle stability. The typical ABS activation sequence is as follows.

Pressure Hold

The electronic brake control module closes the isolation valve and keeps the dump valve closed in order to isolate the slipping wheel when wheel slip occurs. This holds the pressure steady on the brake so that the hydraulic pressure does not increase or decrease.

Pressure Decrease

If a pressure hold does not correct the wheel slip condition, a pressure decrease occurs. The electronic brake control module decreases the pressure to individual wheels during deceleration when wheel slip occurs. The isolation valve is closed and the dump valve is opened. The excess fluid is stored in the accumulator until the pump can return the fluid to the master cylinder or fluid reservoir.

Pressure Increase

After the wheel slip is corrected, a pressure increase occurs. The electronic brake control module increases the pressure to individual wheels during deceleration in order to reduce the speed of the wheel. The isolation valve is opened and the dump valve is closed. The increased pressure is delivered from the master cylinder.

Traction Control

When drive wheel slip is noted, the electronic brake control module will enter traction control mode.

First, the electronic brake control module requests the engine control module to reduce the amount of torque to the drive wheels via a serial data message. The engine control module reduces torque to the drive wheels and reports the amount of delivered torque.

If the engine torque reduction does not reduce drive wheel slip, the electronic brake control module will actively apply the brakes on the slipping drive wheel. During traction control braking, hydraulic pressure in each drive wheel circuit is controlled to prevent the drive wheels from slipping. The electronic brake control module commands the pump motor and appropriate solenoid valves ON and OFF to apply brake pressure to the slipping wheel.

Traction control can be manually disabled by pressing the traction control switch.

Stability Control

Stability control provides added stability during aggressive maneuvers. Yaw rate is the rate of rotation about the vehicle's vertical axis. The stability control is activated when the electronic brake control module determines that the desired yaw rate does not match the actual yaw rate as measured by the yaw rate sensor.

The desired yaw rate is calculated by the electronic brake control module using the following inputs:

- Steering wheel position
- Vehicle speed
- Lateral acceleration

The difference between the desired yaw rate and the actual yaw rate is the yaw rate error, which is a measurement of oversteer or understeer. When a yaw rate error is detected, the electronic brake control module attempts to correct the vehicle's yaw motion by applying brake pressure to one or more of the wheels. The amount of brake pressure which is applied varies, depending on the correction required. The engine torque may be reduced also, if it is necessary to slow the vehicle while maintaining stability.

Stability control activations generally occur in turns during aggressive driving. When braking during stability control activation, the brake pedal may pulsate.

Dynamic Rear Proportioning

The dynamic rear proportioning is a control system that replaces the mechanical proportioning valve. Under certain driving conditions the electronic brake control module will reduce the rear wheel brake pressure by commanding the appropriate solenoid valves ON and OFF.

Hill Start Assist

The hill start assist allows the driver to launch the vehicle without a roll back while moving their foot from the brake pedal to the accelerator pedal. The electronic brake control module calculates the brake pressure, which is needed to hold the vehicle on an incline and locks that pressure for a certain time by commanding the appropriate solenoid valves ON and OFF when the brake pedal is released. Hill start assist is activated when the electronic brake control module determines that the driver wishes to move his vehicle up-hill, either backwards or forwards.

The following inputs are used for hill hold feature:

- Engine torque
- Brake pressure
- Clutch switch if equipped
- Longitudinal acceleration
- Accelerator pedal position
- Brake pedal position sensor
- Transmission gear information

Hydraulic Brake Assist

The hydraulic brake assist function is designed to support the driver in emergency braking situations.

The electronic brake control module receives inputs from the brake pressure sensor. When the electronic brake control module senses an emergency braking situation, the electronic brake control module will actively increase the brake pressure to a specific maximum.

Performance Traction Management

When the traction control switch is pressed twice the performance traction mode is available. The performance traction management is used to enhance the performance of the vehicle on a race track. The performance traction management is divided into two components: corner exit control and launch control. The corner exit control will reduce race track lap times by modulating engine torque for maximum acceleration during vehicle cornering. The launch control will improve vehicle straight-line acceleration from a standstill by controlling the engine speed and modulating engine torque for maximum acceleration once the vehicle is moving. There are five modes adjustable by the driver for changing track conditions based on driver confidence and skill level. The five performance traction management modes integrate magnetic ride control, launch control, traction control, stability control and road conditions are listed below.

Performance Traction Management Mode 1 WET

Mode 1 is intended for use during damp or wet conditions by drivers of all skill levels. The engine torque is managed based on the given track conditions along with the active handling and stability control.

When the traction control is set for wet conditions, with stability control on and magnetic ride control set on Tour, the driver information center displays:

- Perf Traction
- 1-WET
- Active Handling On
- Suspension Mode Tour

Performance Traction Management Mode 2 DRY

Mode 2 is intended for use on dry track conditions by less experienced drivers or those learning a new track.

The engine torque is managed based on the given track conditions along with the active handling and stability control.

When the traction control is set for dry conditions, with stability control on and magnetic ride control set on Tour, the driver information center displays:

- 2-DRY

Performance Traction Management Mode 3

Mode 3 is intended for use on dry track conditions by drivers who are familiar with the track they are driving. The engine torque is managed based on the given track conditions along with the active handling and stability control.

When the traction control is set on Sport 1, with stability control on and magnetic ride control set on Sport, the driver information center displays:

- 3-SPORT 1

- Suspension Mode Sport

Performance Traction Management Mode 4

Mode 4 is intended for use on dry track conditions by drivers who are familiar with the track they are driving. The engine torque is managed based on the given track conditions along with the active handling and stability control.

When the traction control is set on Sport 2, with stability control off and magnetic ride control set on Sport, the driver information center displays:

- 4-SPORT 2

- Active Handling Off

Performance Traction Management Mode 5

Mode 5 is intended for use on dry track conditions by experienced drivers who are familiar with the track they are driving. Launch control is tuned for race or drag strip prepping. This mode will require more driver skill than all the other modes. The engine torque is maximized for cornering speed.

When the traction control is on Race, with stability control off and magnetic ride control set on Track, the driver information center displays:

- 5-RACE

- Suspension Mode 1 TRACK

Driver Information Indicators

Brake Warning Indicator

The instrument cluster turns the brake warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The electronic brake control module detects a fault and sends a serial data message to the instrument cluster requesting illumination.
- The body control module (BCM) detects that the park brake is engaged. The instrument cluster receives a serial data message from the BCM requesting illumination.

ABS Indicator

The instrument cluster turns the ABS indicator ON when the following occurs:

- The electronic brake control module detects a malfunction which disables the ABS and sends a serial data message to the instrument cluster requesting illumination.

Traction Control/Stability Control Indicator

The instrument cluster turns the traction control/stability control indicator ON when the following occurs:

- The electronic brake control module detects a malfunction which disables the traction control or stability control and sends a serial data message to the instrument cluster requesting illumination.

Traction Control Off Indicator

The instrument cluster turns the traction control off indicator ON when the following occurs:

- The driver manually disables the traction control by pressing the traction control switch. The electronic brake control module sends a serial data message to the instrument cluster requesting illumination.

Stability Control Off Indicator

The instrument cluster turns the stability control off indicator ON when the following occurs:

- The driver may disable the stability control when selecting the performance traction management mode 4 or mode 5. The electronic brake control module sends a serial data message to the instrument cluster requesting illumination.

ABS Description and Operation (w/o F55) (Article 10527)

This vehicle is equipped with a Bosch ABS 8.0 brake system. The electronic brake control module and the brake pressure modulator are serviced separately. The brake pressure modulator uses a four circuit configuration to control hydraulic pressure to each wheel independently.

The following vehicle performance enhancement systems are provided.

- ABS
- Traction control
- Stability control
- Dynamic rear proportioning

- Hill start assist
- Hydraulic brake assist

The following components are involved in the operation of the above systems:

- Electronic brake control module – The electronic brake control module controls the system functions and detects failures. It supplies voltage to the solenoid valves and pump motor.
- Brake pressure modulator – The brake pressure modulator contains the following components:
 - Hydraulic pump with pump motor
 - Four isolation solenoid valves
 - Four dump solenoid valves
 - Two traction control/stability control prime solenoid valves
 - Two traction control/stability control isolation solenoid valves
 - Pressure sensor
 - High pressure accumulator
 - Low pressure accumulator
- Multi-axis acceleration sensor – The yaw rate and lateral acceleration sensors are combined into one multi-axis acceleration sensor module, external to the electronic brake control module. The electronic brake control module receives serial data message inputs from the yaw rate and lateral acceleration sensor and activates stability control depending on multi-axis acceleration sensor module input.
- Steering angle sensor – The electronic brake control module receives serial data message inputs from the steering angle sensor module. The steering angle sensor signal is used to calculate the desired yaw rate.
- Traction control switch – Traction control and stability control are manually disabled or enabled by pressing the traction control switch.
- Wheel speed sensors – The electronic brake control module sends a 12 V reference voltage to each wheel speed sensor. As the wheel spins, the wheel speed sensor produces an alternating current square wave signal. The electronic brake control module uses the frequency of the square wave signal to calculate the wheel speed.

ABS

When wheel slip is detected during a brake application, an ABS event occurs. During ABS braking, hydraulic pressure in the individual wheel circuits is controlled to prevent any wheel from slipping. A separate hydraulic line and specific solenoid valves are provided for each wheel. The ABS can decrease, hold, or increase hydraulic pressure to each wheel. The ABS does not, however, increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During ABS braking, a series of rapid pulsations is felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as the electronic brake control module responds to wheel speed sensor inputs and attempts to prevent wheel slip. These pedal pulsations are present only during ABS braking and stop when normal braking is resumed or when the vehicle comes to a stop. A ticking or popping noise may also be heard as the solenoid valves cycle rapidly. During ABS braking on dry pavement, intermittent chirping noises may be heard as the tires approach slipping. These noises and pedal pulsations are considered normal during ABS operation.

Vehicles equipped with ABS may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking is no different than that of previous non ABS systems. Maintaining a constant force on the brake pedal provides the shortest stopping distance while maintaining vehicle stability. The typical ABS activation sequence is as follows.

Pressure Hold

The electronic brake control module closes the isolation valve and keeps the dump valve closed in order to isolate the slipping wheel when wheel slip occurs. This holds the pressure steady on the brake so that the hydraulic pressure does not increase or decrease.

Pressure Decrease

If a pressure hold does not correct the wheel slip condition, a pressure decrease occurs. The electronic brake control module decreases the pressure to individual wheels during deceleration when wheel slip occurs. The isolation valve is closed and the dump valve is opened. The excess fluid is stored in the accumulator until the pump can return the fluid to the master cylinder or fluid reservoir.

Pressure Increase

After the wheel slip is corrected, a pressure increase occurs. The electronic brake control module increases the pressure to individual wheels during deceleration in order to reduce the speed of the wheel. The isolation valve is opened and the dump valve is closed. The increased pressure is delivered from the master cylinder.

Traction Control

When drive wheel slip is noted, the electronic brake control module will enter traction control mode.

First, the electronic brake control module requests the engine control module (ECM) to reduce the amount of torque to the drive wheels via a serial data message. The ECM reduces torque to the drive wheels and reports the amount of delivered torque.

If the engine torque reduction does not reduce drive wheel slip, the electronic brake control module will actively apply the brakes on the slipping drive wheel. During traction control braking, hydraulic pressure in each drive wheel circuit is controlled to prevent the drive wheels from slipping. The electronic brake control module commands the pump motor and appropriate solenoid valves ON and OFF to apply brake pressure to the slipping wheel.

Traction control can be manually disabled by pressing the traction control switch.

Stability Control

Stability control provides added stability during aggressive maneuvers. Yaw rate is the rate of rotation about the vehicle's vertical axis. The stability control is activated when the electronic brake control module determines that the desired yaw rate does not match the actual yaw rate as measured by the yaw rate sensor .

The desired yaw rate is calculated by the electronic brake control module using the following inputs:

- Steering wheel position
- Vehicle speed
- Lateral acceleration

The difference between the desired yaw rate and the actual yaw rate is the yaw rate error, which is a measurement of oversteer or understeer. When a yaw rate error is detected, the electronic brake control module attempts to correct the vehicle's yaw motion by applying brake pressure to one or more of the wheels. The amount of brake pressure which is applied varies, depending on the correction required. The engine torque may be reduced also, if it is necessary to slow the vehicle while maintaining stability.

Stability control activations generally occur in turns during aggressive driving. When braking during stability control activation, the brake pedal may pulsate.

Dynamic Rear Proportioning

The dynamic rear proportioning is a control system that replaces the mechanical proportioning valve. Under certain driving conditions the electronic brake control module will reduce the rear wheel brake pressure by commanding the appropriate solenoid valves ON and OFF.

Hill Start Assist

The hill start assist allows the driver to launch the vehicle without a roll back while moving their foot from the brake pedal to the accelerator pedal. The electronic brake control module calculates the brake pressure, which is needed to hold the vehicle on an incline and locks that pressure for a certain time by commanding the appropriate solenoid valves ON and OFF when the brake pedal is released. Hill start assist is activated when the electronic brake control module determines that the driver wishes to move his vehicle up-hill, either backwards or forwards.

The following inputs are used for hill hold feature:

- Engine torque
- Brake pressure
- Clutch switch if equipped
- Longitudinal acceleration
- Accelerator pedal position
- Brake pedal position sensor
- Transmission gear information

Hydraulic Brake Assist

The hydraulic brake assist function is designed to support the driver in emergency braking situations.

The electronic brake control module receives inputs from the brake pressure sensor . When the electronic brake control module senses an emergency braking situation, the electronic brake control module will actively increase the brake pressure to a specific maximum.

Driver Information Indicators

Brake Warning Indicator

The instrument cluster turns the brake warning indicator ON when the following occurs:

- The instrument cluster performs the bulb check.
- The electronic brake control module detects a fault and sends a serial data message to the instrument cluster requesting illumination.
- The body control module (BCM) detects that the park brake is engaged. The instrument cluster receives a serial data message from the BCM requesting illumination.

ABS Indicator

The instrument cluster turns the ABS indicator ON when the following occurs:

- The electronic brake control module detects a malfunction which disables the ABS and sends a serial data message to the instrument cluster requesting illumination.

Traction Control/Stability Control Indicator

The instrument cluster turns the traction control/stability control indicator ON when the following occurs:

- The electronic brake control module detects a malfunction which disables the traction control or stability

control and sends a serial data message to the instrument cluster requesting illumination.

Traction Control Off Indicator

The instrument cluster turns the traction control off indicator ON when the following occurs:

- The driver manually disables the traction control when the traction control switch is pressed and released.

The electronic brake control module sends a serial data message to the instrument cluster requesting illumination.

Stability Control Off Indicator

The instrument cluster turns the stability control off indicator ON when the following occurs:

- The driver manually disables the stability control when the traction control switch is pressed and held for five seconds. The electronic brake control module sends a serial data message to the instrument cluster

requesting illumination.

Antilock Brake System Schematics (Article 10582)

Figure 1: Power, Ground, Data Communication, and Traction Control

Figure 2: Wheel Speed Sensors

Figure 3: Stability Sensors

Anti-Lock Brakes (Article 11047)

Anti-Lock Brakes

Page 1 of 2

Page 2 of 2

Antilock Brake System - Fastener Specifications (Article 10584)

Application Specification

Metric English

Brake Pipe Fitting 16 Nm 12 lb ft

Brake Pipe Fitting- Master Cylinder 23 Nm 17 lb ft

Brake Pressure Modulator Valve (BPMV) Nut 8 Nm 71 lb in

Electronic Brake Control Module (EBCM) Bolt 3 Nm 27 lb in

Wheel Speed Sensor Bolt 9 Nm 80 lb in

Yaw Sensor Nut 9 Nm 80 lb in

All New Technical Service Bulletins (itype_432)

Tsbs

- Multiple U-code Diagnostic Information – With one having symptom Byte 71 (PIT5569C, 2024/09/06)

All Technical Service Bulletins (itype_100)

Tsbs

- ABS/TCS - DTC's C0710 SYM71 (PIT5076D, 2014/02/10)
- Traction Control Lamp Flashes Under Hard Accel. At High Speed (16-NA-223, 2016/07/11)
- Multiple U-code Diagnostic Information – With one having symptom Byte 71 (PIT5569C, 2024/09/06)
- Ratchet Click or Grind Noise From Front of Vehicle Slow Speeds (16-NA-298, 2016/09/13)

Customer Interest Bulletins (itype_109)

Tsbs

- Traction Control Lamp Flashes Under Hard Accel. At High Speed (16-NA-223, 2016/07/11)
- Ratchet Click or Grind Noise From Front of Vehicle Slow Speeds (16-NA-298, 2016/09/13)

Repair Tips (itype_110)

Tsbs

- ABS/TCS - DTC's C0710 SYM71 (PIT5076D, 2014/02/10)

Electronic Brake Control Module Scan Tool Information (Article 10776)

The Electronic Brake Control Module scan tool data parameters list contains all ABS related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists.

Parameter System State Expected Value Description

Operating Conditions: Ignition ON

ABS Pump Motor Voltage — 0 V The scan tool displays 0–14 V depending on the commanded pump motor voltage.

Antilock Braking System — Off The scan tool displays On or Off. On is displayed when the ABS is disabled.

Brake Fluid Level Sensor — OK The scan tool displays OK when the brake fluid is at correct level and Low when the brake fluid is low.

Brake Pedal Position Sensor Brake pedal released Inactive The scan tool displays Inactive or Active depending on the state of the brake pedal.

Brake pedal applied Active

Brake Pressure Sensor Brake pedal released 0–1 V The scan tool displays 0–5 V depending on the applied hydraulic brake pressure.

Brake pedal applied 1–5 V

Delivered Torque No Acceleration 0% The scan tool displays 0–100% depending on the how much torque the engine is delivering.

Acceleration Varies

Dynamic Rear Proportioning Status — Off The scan tool displays On or Off. On is displayed when the dynamic rear proportioning system is disabled.

Front Isolation Solenoid Valve Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the front isolation solenoid valve is commanded ON.

Front Prime Solenoid Valve Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the front prime solenoid valve is commanded ON.

Lateral Acceleration Signal — Varies The scan tool displays 0–5 V depending on the vehicle's lateral acceleration.

Left Front Isolation Solenoid Valve Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the left front isolation solenoid valve is commanded ON.

Left Front Dump Solenoid Valve Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the left front dump solenoid valve is commanded ON.

Left Front Wheel Speed Sensor — 0 km/h (0 MPH) The scan tool displays km/h (MPH) depending on the current speed of the left front wheel speed sensor .

Left Rear Isolation Solenoid Valve Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the left rear isolation solenoid valve is commanded ON.

Left Rear Dump Solenoid Valve Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the left rear dump solenoid valve is commanded ON.

Left Rear Wheel Speed Sensor — 0 km/h (0 MPH) The scan tool displays km/h (MPH) depending on the current speed of the left rear wheel speed sensor .

Pump Motor Relay Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the pump motor is commanded ON.

Rear Prime Solenoid Valve Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the rear prime solenoid valve is commanded ON.

Requested Torque — 100% The scan tool displays 0–100% depending on the how much torque is requested.

Right Front Isolation Solenoid Valve Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the right front isolation solenoid valve is commanded ON.

Right Front Dump Solenoid Valve Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the right front dump solenoid valve is commanded ON.

Right Front Wheel Speed Sensor — 0 km/h (0 MPH) The scan tool displays km/h (MPH) depending on the current speed of the right front wheel speed sensor .

Right Rear Isolation Solenoid Valve Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the right rear isolation solenoid valve is commanded ON.

Right Rear Dump Solenoid Valve Feedback — Inactive The scan tool displays Inactive or Active. Active is displayed when the right rear dump solenoid valve is commanded ON.

Right Rear Wheel Speed Sensor — 0 km/h (0 MPH) The scan tool displays km/h (MPH) depending on the current speed of the right rear wheel speed sensor.

Steering Column Position Steering wheel in straight position –5 to +5° The scan tool displays °. This is the current position of the steering angle sensor .

Steering wheel turned left until stop 450–550°

Steering wheel turned right until stop –550 to –450°

System Voltage — 11–14 V The scan tool displays V. This is the current battery voltage.

Traction Control System — Off The scan tool displays On or Off. On is displayed when traction control is disabled.

Vehicle Stability System — Off The scan tool displays On or Off. On is displayed when stability control is disabled.

Vehicle Stability System Relay Feedback — Active The scan tool displays Inactive or Active depending on the

state of the stability control.

Yaw Rate Signal — Varies The scan tool displays 0–5 V depending on the vehicle's yaw rate.

Output Control Description

ABS Left Front Solenoid Valves Commands the solenoid valves ON or OFF.

ABS Left Rear Solenoid Valves Commands the solenoid valves ON or OFF.

ABS Pump Motor Commands the ABS pump motor Increase or Decrease.

ABS Right Front Solenoid Valves Commands the solenoid valves ON or OFF.

ABS Right Rear Solenoid Valves Commands the solenoid valves ON or OFF.

Automated Brake Bleed This is used in order to bleed the ABS hydraulics.

Traction Control Left Front Solenoid Valves Commands the solenoid valves ON or OFF.

Traction Control Left Rear Solenoid Valves Commands the solenoid valves ON or OFF.

Traction Control Right Front Solenoid Valves Commands the solenoid valves ON or OFF.

Traction Control Right Rear Solenoid Valves Commands the solenoid valves ON or OFF.

Symptoms - Antilock Brake System (Article 10565)

- Perform the Diagnostic System Check - Vehicle before using the symptom tables in order to verify that all of the following are true:

- There are no DTCs set.

- The control modules can communicate via the serial data link.

- Review the system description and operation in order to familiarize yourself with the system functions.

Refer to ABS Description and Operation .

Visual/Physical Inspection

- Inspect for aftermarket devices which could affect the operation of the ABS .

- Inspect the easily accessible or visible system components, for obvious damage or conditions, which could cause the symptom.

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to Testing for Intermittent Conditions and Poor Connections .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

- ABS Indicator Malfunction

- Traction Control/Stability Control Indicator Malfunction

- Brake Warning Indicator Malfunction

ABS Indicator Malfunction (Article 10528)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.

- Review Strategy Based Diagnosis for an overview of the diagnostic approach.

- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

The instrument cluster turns ON the ABS indicator for 5 seconds after the ignition is turned ON, or when the electronic brake control module detects a fault and sends a serial data message to the instrument cluster commanding the indicator ON.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing

- Connector Repairs

- Testing for Intermittent Conditions and Poor Connections

- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

- Ignition ON.

- Verify that no DTCs are set.
- If any DTCs are set Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
- If no DTCs are set
- Verify the instrument cluster ABS indicator turns ON and OFF when commanding All Indicators ON and OFF with a scan tool.
- If the ABS indicator does not turn ON and OFF Replace the P16 instrument cluster.
- If the ABS indicator turns ON and OFF
- Verify the ABS indicator turns OFF 5 seconds after the ignition is turned ON.
- If the ABS indicator does not turn OFF Replace the K17 electronic brake control module.
- If the ABS indicator turns OFF
- All OK.

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Control Module References for electronic brake control module or instrument cluster replacement, programming and setup

Hill Start Assist Malfunction (Article 10564)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Circuit/System Description

The hill start assist allows the driver to launch the vehicle without roll back when moving their foot from the brake pedal to the accelerator pedal while on a slope or incline. The hill start assist function activates automatically based on the percent of the hill grade which is estimated by the longitudinal accelerometer. The electronic brake control module calculates the brake pressure, which is needed to hold the vehicle on an incline and locks that pressure by commanding the appropriate solenoid valves ON and OFF. The release of the hill start assist is based on the position of the accelerator pedal and the required engine torque is enough to prevent the vehicle from rolling down the hill.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

- Ignition ON.
- Verify that no other DTCs are set.
- If any other DTCs are set Refer to Diagnostic Trouble Code (DTC) List - Vehicle .
- If no other DTCs are set
- Perform the Vehicle Yaw Sensor Learn .

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

Traction Control/Stability Control Indicator Malfunction (w/ F55) (Article 10566)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit Short to Ground Open/High Resistance Short to Voltage Signal Performance

Signal B2745 02 1 1 —

Ground — 1 — —

1. The traction control switch is inoperative.

Circuit/System Description

The Instrument Cluster illuminates the Traction/stability Control, Traction Control Off, and the Stability Control Off indicator for five seconds after ignition ON. The Electronic Brake Control Module will request the Instrument Cluster via serial data to turn the Traction/stability Control, Traction Control Off, and the Stability Control Off indicator ON when a fault is set or when the vehicle is entering the performance traction mode. When the Electronic Brake Control Module detects a fault it sends a serial data message to the Instrument Cluster commanding the Traction/stability Control indicator ON.

The Body Control Module monitors the traction control switch. When the traction control switch is pressed once, the Body Control Module will request the Electronic Brake Control Module via serial data to disable the traction control. When the Traction Control Switch is pressed twice within five seconds the performance traction mode is available and enters the Performance Traction Control Mode 2–Dry. The Electronic Brake Control Module will request the Instrument Cluster via serial data to turn the Traction Control Off indicator and Stability Control Off indicator ON to notify the driver of the deactivation.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing

- Connector Repairs

- Testing for Intermittent Conditions and Poor Connections

- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

- Ignition ON.

- Verify the Instrument Cluster indicators listed below turn ON and OFF when commanding the All Indicators ON and OFF with a scan tool.

- Traction/stability Control indicator

- Traction Control Off indicator

- Stability Control Off indicator

- If any indicator does not turn ON and OFF Replace the P16 Instrument Cluster.

- If all indicators turn ON and OFF

- Verify the scan tool Body Control Module Traction Control Switch parameter changes between Active and Inactive when pressing and releasing the S48E Multifunction Switch-Center Console.

- If the parameter does not change Refer to Circuit/System Testing.

- If the parameter changes

- All OK.

Circuit/System Testing

- Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S48E Multifunction Switch-Center Console. It may take up to 2 minutes for all vehicle systems to power down.

- Test for less than 5 Ω between the ground circuit terminal 2 and ground.

- If 5 Ω or greater

- Ignition OFF.

- Test for less than 2 Ω in the ground circuit end to end.

- If 2 Ω or greater, repair the open/high resistance in the circuit.

- If less than 2 Ω , repair the open/high resistance in the ground connection.

- If less than 5 Ω

- Verify the scan tool Body Control Module Traction Control Switch parameter is Inactive.

- If not Inactive

- Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module.

- Test for infinite resistance between the signal circuit and ground.

- If less than infinite resistance, repair the short to ground on the circuit.

- If infinite resistance, replace the K9 Body Control Module.

- If Inactive
- Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground.
- Verify the scan tool Traction Control Switch parameter is Active.
- If not Active
- Ignition OFF, disconnect the X2 harness connector at the K9 Body Control Module, ignition ON.
- Test for less than 1 V between the signal circuit and ground.
- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V
- Test for less than 2 Ω in the signal circuit end to end.
- If less than 2 Ω , replace the K9 Body Control Module.
- If Active
- Test or replace the S48E Multifunction Switch-Center Console.

Component Testing

- Ignition OFF, disconnect the harness connector at the S48E Multifunction Switch-Center Console.
- Test for infinite resistance between the signal circuit terminal 4 and the ground circuit terminal 2 with the switch in the open position.
- If less than infinite resistance Replace the S48E Multifunction Switch-Center Console.
- Test for less than 2 Ω between the signal circuit terminal 4 and the ground circuit terminal 2 with the switch in the closed position.
- If 2 Ω or greater Replace the S48E Multifunction Switch-Center Console.
- If less than 2 Ω

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Electronic Traction Control Switch Replacement
- Control Module References for Body Control Module replacement or Instrument Cluster, programming and setup

Traction Control/Stability Control Indicator Malfunction (w/o F55) (Article 10568)

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

Diagnostic Fault Information

Circuit Short to Ground Open/High Resistance Short to Voltage Signal Performance

Signal B2745 02 1 1 —

Ground — 1 — —

1. The traction control switch is inoperative.

Circuit/System Description

The instrument cluster illuminates the traction control/stability control-active indicator for 5 seconds after ignition ON. The electronic brake control module will request the instrument cluster via serial data to turn the traction control/stability control-active indicator ON (flashing) when the system is in traction control or stability control mode. When the electronic brake control module detects a fault it sends a serial data message to the instrument cluster commanding the traction control/stability control-active indicator ON. The body control module monitors the stability control switch. When the traction control switch is pressed once, the body control module will request the electronic brake control module via serial data to disable the traction control. When the traction control switch is pressed for 5 seconds, the body control module will request the electronic brake control module to disable the stability control. The electronic brake control module will request the instrument cluster via serial data to turn the traction control off indicator and stability control off indicator ON to notify the driver of the deactivation.

Reference Information

Schematic Reference

Antilock Brake System Schematics

Connector End View Reference

Component Connector End Views

Description and Operation

ABS Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

- Ignition ON.
- Verify the instrument cluster indicators listed below turn ON and OFF when commanding the All Indicators ON and OFF with a scan tool.
- Traction control/stability control-active indicator
- Traction control off indicator
- Stability control off indicator
- If any indicator does not turn ON and OFF Replace the P16 instrument cluster.
- If all indicators turn ON and OFF
- Verify the scan tool Body Control Module, Traction Control Switch parameter changes between Active and Inactive when pressing and releasing the traction control switch.
- If the parameter does not change Refer to Circuit/System Testing.
- If the parameter changes
- All OK.

Circuit/System Testing

- Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the S75 traction control switch. It may take up to 2 minutes for all vehicle systems to power down.
- Test for less than 5 Ω between the ground circuit terminal 2 and ground.
- If 5 Ω or greater
- Ignition OFF.
- Test for less than 2 Ω in the ground circuit end to end.
- If 2 Ω or greater, repair the open/high resistance in the circuit.
- If less than 2 Ω , repair the open/high resistance in the ground connection.
- If less than 5 Ω
- Verify the scan tool Body Control Module, Traction Control Switch parameter is Inactive.
- If not Inactive
- Ignition OFF, disconnect the X2 harness connector at the K9 body control module.
- Test for infinite resistance between the signal circuit and ground.
- If less than infinite resistance, repair the short to ground on the circuit.
- If infinite resistance, replace the K9 body control module.
- If Inactive
- Install a 3 A fused jumper wire between the signal circuit terminal 7 and ground.
- Verify the scan tool Traction Control Switch parameter is Active.
- If not Active
- Ignition OFF, disconnect the X2 harness connector at the K9 body control module, ignition ON.
- Test for less than 1 V between the signal circuit and ground.
- If 1 V or greater, repair the short to voltage on the circuit.
- If less than 1 V
- Test for less than 2 Ω in the signal circuit end to end.
- If less than 2 Ω , replace the K9 body control module.
- If Active
- Test or replace the S75 traction control switch.

Component Testing

- Ignition OFF, disconnect the harness connector at the S75 traction control switch.
- Test for infinite resistance between the signal circuit terminal 7 and the ground circuit terminal 2 with the switch in the open position.
- If less than infinite resistance Replace the S75 traction control switch.
- Test for less than 2 Ω between the signal circuit terminal 7 and the ground circuit terminal 2 with the switch in the closed position.
- If 2 Ω or greater Replace the S75 traction control switch.
- If less than 2 Ω

Repair Instructions

Perform the Diagnostic Repair Verification after completing the repair.

- Electronic Traction Control Switch Replacement
- Control Module References for body control module replacement or instrument cluster, programming and setup

Antilock Brake System - Special Tools (Article 10583)

Illustration Tool Number/ Description

[Click for full-size image](#) EL 35616-F J 35616 Terminal Test Kit

Noise (itype_156)

Tsbs

- Ratchet Click or Grind Noise From Front of Vehicle Slow Speeds (16-NA-298, 2016/09/13)