# SECTION 4E

# ABS SYSTEM AND TRACTION CONTROL SYSTEM

## TABLE OF CONTENTS

# DESCRIPTION AND OPERATION

## ABS(ANTI-LOCK BRAKE SYSTEM)

When wheel slip is noted during a brake application, the ABS enters antilock mode. During antilock braking, hydraulic pressure in the individual wheel circuits is controlled in order 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 brake. However, the ABS cannot increase hydraulic pressure above the amount which is transmitted by the master cylinder during braking.

During antilock braking, a series of rapid pulsations will be felt in the brake pedal. These pulsations are caused by the rapid changes in position of the individual solenoid valves as they respond to their desired wheel speed. This pedal pulsation is present during antilock braking and stops 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 rapidly cycle. During antilock braking on dry pavement, the tires may make intermittent chirping noises as they approach slipping. These noises and pedal pulsations should be considered normal during antilock operation.

The vehicle may be stopped by applying normal force to the brake pedal. Brake pedal operation during normal braking should be no different than previous systems. Maintaining a constant force on the pedal will provide the shortest stopping distance while maintaining vehicle stability.

### Basic Knowledge Required

Before using this section, it is important that you have a basic knowledge of the following items. Without this knowledge, it will be difficult to use the diagnostic procedures contained in this section.

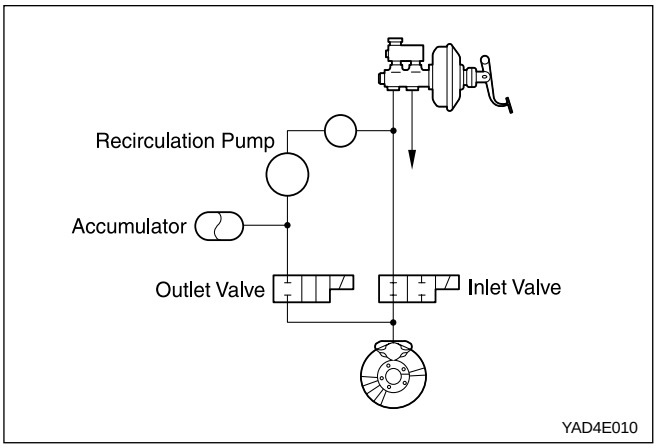
**Basic Electrical Circuits** - You should understand the basic theory of electricity and know the meaning of voltage, current (amps) And resistance (ohms). You should understand what happens in a circuit with an open or shorted wire. You should be able to read and understand a wiring diagram.

**Use of Circuit Testing Tools** - You should know how to use a test light and how to bypass components to test circuits using fused jumper wires. You should be familiar with a digital multimeter. You should be able to measure voltage, resistance, and current, and be familiar with the controls and how to use them correctly.

### Basic Hydraulic System

Each solenoid valve consists of one inlet valve and one outlet valve in order to become the channel.

The inlet valve and the outlet valve close/open by the electrical signal and control the hydraulic pressure as increase, decrease and hold.




### ABS System Components

The ABS 5.3 Antilock Braking System (ABS) consists of a conventional hydraulic brake system plus antilock components. The conventional brake system includes a vacuum booster, master cylinder, front disc brakes, rear disc brakes, interconnecting hydraulic brake pipes and hoses, brake fluid level switch and the BRAKE indicator.

The ABS components include a hydraulic unit, an electronic brake control module (EBCM), two system fuses, four wheel speed sensors (one at each wheel), interconnecting wiring, the ABS indicator, the EBD indicator and the TCS indicator, See “ABS Component Locator” in this section for the general layout of this system.

The basic hydraulic unit configuration consists of hydraulic check valves, two solenoid valves for each wheel, a hydraulic pump, and two accumulators. The hydraulic unit controls hydraulic pressure to the front calipers and rear calipers by modulating hydraulic pressure to prevent wheel lockup.

Units equipped with TCS add two more valves for each drive wheel for the purpose of applying the brake to a wheel that is slipping. This is done with pressure from the hydraulic pump in the unit. There is also a TCS indicator lamp on the instrument panel to alert the driver to the fact that the TCS system is active. The components identified in the drawing are those added to the basic ABS 5.3 system to provide traction control.

Nothing the hydraulic unit or the EBCM is serviceable. In the event of any failure, the entire ABS unit with attached EBCM must be replaced. For more information, refer to “Base Braking Mode” and “Antilock Braking Mode” in the section.

# TRACTION CONTROL SYSTEM (TCS) DESCRIPTION

## General Information

The traction control system (TCS) is a traction system by means of brake intervention only, available in a low speed range (< 60 kph).

It works on µ-split roads with sidewise different friction coefficients.

The spinning driven wheel is braked and the drive torque can be transferred to the wheel on the high-µ side. During TCS active, the TCS information lamp is blinking.

The temperature of the brakes is calculated by a mathematical model and TCS is switched passive if the calculated temperature is greater than a threshold value (500 °C). TCS is permitted again, when the calculated temperature is less than 350 °C.

## Lamp Concepts

The system is equipped with an TCS information lamp, which is blinking during TCS operation.

The activation of the EBD, TCS warning lamp and the TCS info lamp is summarized in the following table:

| | Ignition ON | ABS Operation | TCS Operation | System Failure (EBD, ABS or TCS are Not Distinguished) | TCS Passive Due to Temperature Model |
|---|---|---|---|---|---|
| **ABS Warning Lamp** | 2 second on for lamp check | OFF | OFF | ON | OFF |
| **TCS Info Lamp** | 2 second on for lamp check | OFF | Blinking (FLASHING) | OFF | ON |
| **EBD Warning Lamp** | 2 second on for lamp check | EBD operation/OFF | OFF | ON | OFF |

## Automatic Brake Differential (ABD)

ABD (Automatic Brake Differential) system is a type of the TCS (ASR) system and substitutes the function of the mechanical LSD (Limited Slip Differential) system.

ABD system operates by controlling the braking forces only under 60km/h.

## TCS System Function

Traction control does not have any effect on the operation of the vehicle until the control module detects one or both of the front wheels rotating faster than the rear wheels. At this time, the electronic brake control module (EBCM) requests the powertrain control module to reduce the amount of torque applied to the drive wheels. The powertrain control module does this by retarding timing and selectively turning off fuel injectors. The EBCM applies the front brakes, thus reducing torque to the front wheels. Once the front wheel begins to rotate at the same speed as the rear wheels, the system returns full control to the driver. During traction control mode, if the brake is applied to only one front wheel, most of the torque from the engine is directed to the other front wheel which improves the traction of the vehicle.

## Pressure Modulation

Depending on the control deviation and the wheel acceleration of the spinning wheel, pressure increase, hold and decrease are made.

The pressure modulation is done with the conventional control with the valves. Prime valve, inlet valve and outlet valve according to the following table:

| | Increase | Hold | Decrease |
|---|---|---|---|
| **Prime Valve** | Open | Open | Open |
| **Pilot Valve** | Closed | Closed | Closed |
| **Inlet Valve** | Open | Closed | Closed |
| **Outlet Valve** | Closed | Closed | Open |

## Speed Range

TCS is available in the speed range ≤ 60 kph.

Above 60 kph vehicle speed, TCS is passive.

It is possible to initiate TCS operation up to a vehicle speed of 55 kph.

## Control Algorithm

The input signals for the control algorithm are the filtered wheel speed signals from the ABS speed processing.

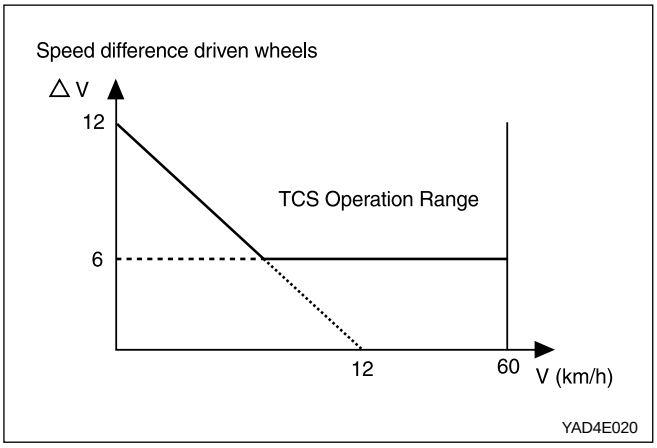
With the speed difference of the driven wheels, the

control deviation is calculated.

If the control deviation exceeds a certain threshold value, the wheel with the greater slip is braked actively.

The threshold value depends on the vehicle speed:

It is reduced with increasing vehicle speed down to a constant value.




△V = Faster rear wheel speed - Slower rear wheel speed

V = Vehicle speed

* TCS is switched passive if the calculated temperature is greater than a threshold value (500 °C).

- TCS (ABD) Indicator turns on but TCS is permitted again, when the calculated temperature is less than 350 °C.

## Temperature Model

TCS operation is a high thermal load for the brakes.

To avoid any damages at the brakes, the disk temperature is calculated with a mathematical model for each driven wheel separately, After ignition on, the calculation starts with 30 °C and then three different phases are evaluated separately and added:

TCS operation, braking and cooling phase.

If the temperature is higher than 500 °C, TCS is disabled for this wheel.

It is permitted again, if the model has calculated down the 350 °C.

# EBD (ELECTRONIC BRAKE FORCE DISTRIBUTION) SYSTEM

## System Description

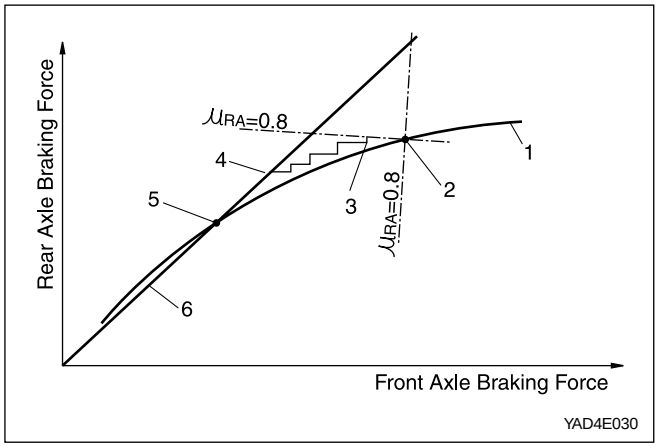
As an add-on logic to the ABS base algorithm, EBD works in a range in which the intervention thresholds for ABS control are not reached yet.

EBD ensures that the rear wheels are sensitively monitored for slip with respect to the front axle. If slip is detected, the inlet valves for the rear wheels are switched to pressure hold to prevent a further increase in pressure at the rear-wheel breaks, thus electronically reproducing a pressure-reduction function at the rear-wheel brakes.

ABS features an enhanced algorithm which includes control of the brake force distribution between the front and rear axles. This is called Electronic Brake Distribution. In an unloading car condition the brake efficiency is comparable to the conventional system but for a fully loaden vehicle the efficiency of the EBD system is higher due to the better use of rear axle braking capability.

## The Benefits of EBD

- Elimination of conventional proportioning valve EBD utilizes the existing rear axle wheel speed sensor to monitor rear wheel slip.
- Based on many variables in algorithm a pressure hold, increase and/or decrease pulsetrain may be triggered at the rear wheels insuring vehicle stability.
- Vehicle approaches the ideal brake force distribution (front to rear).
- Constant brake force distribution during vehicle lifetime.
- EBD function is monitored via ABS safety logic (conventional proportioning valves are not monitorable).
- “Keep alive” function.

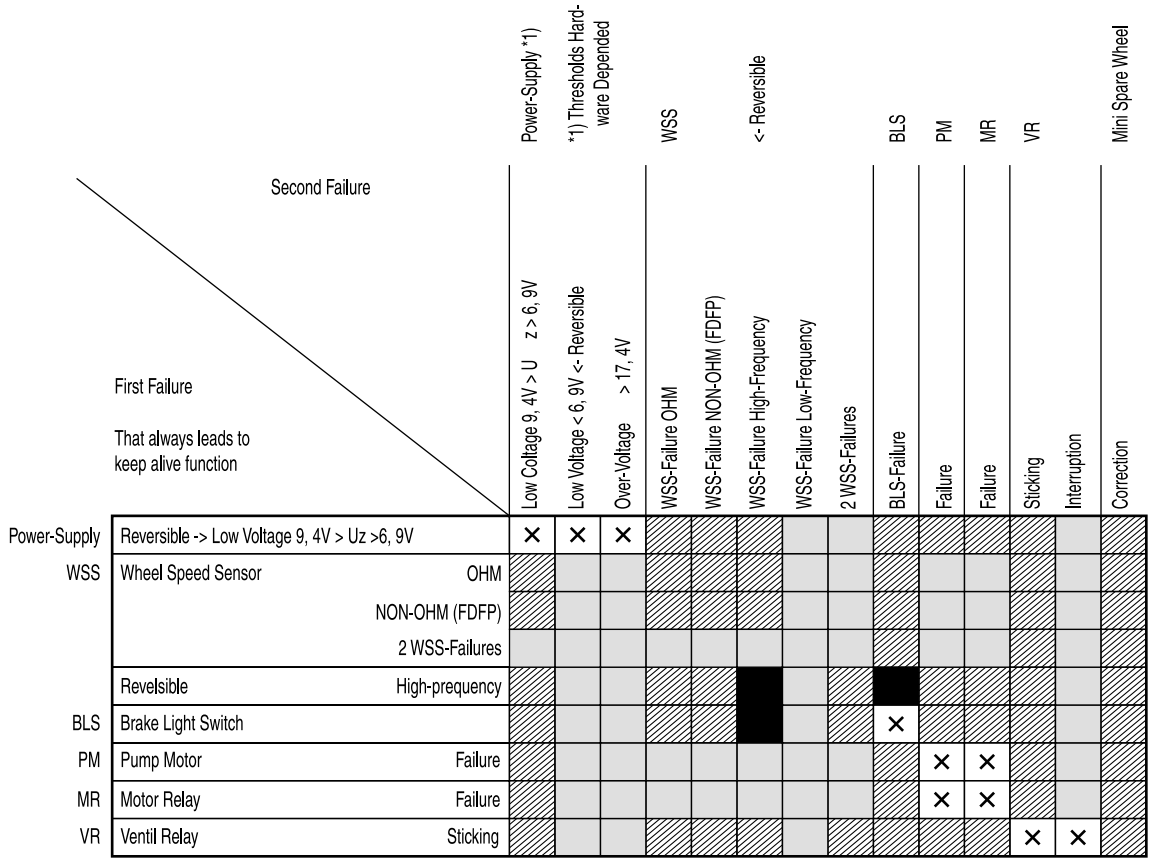



### Service Precautions

Observe the following general precautions during any ABS/TCS service. Failure to adhere to these precautions may result in ABS/TCS system damage.

1. Disconnect the EBCM harness connector before performing the electric welding procedures.
2. Carefully note the routing of the ABS/TCS wiring and wring components during removal. The ABS/TCS components are extremely sensitive to EMI (eletromagnetic interference). Proper mounting is critical during component service.
3. Disconnect the EBCM connector with the ignition OFF.
4. Do not hang the suspension components from the wheel speed sensor cables. The cables may be damaged.
5. Do not use petroleum based fluids in the master cylinder. Do not use any containers previously used for petroleum based fluids. Petroleum causes swelling and distortion of the rubber components in the hydraulic brake system, resulting in water entering the system and lowering the fluid boiling point.

## Electronic Brake-Force Distribution (EBD) Failure Matrix

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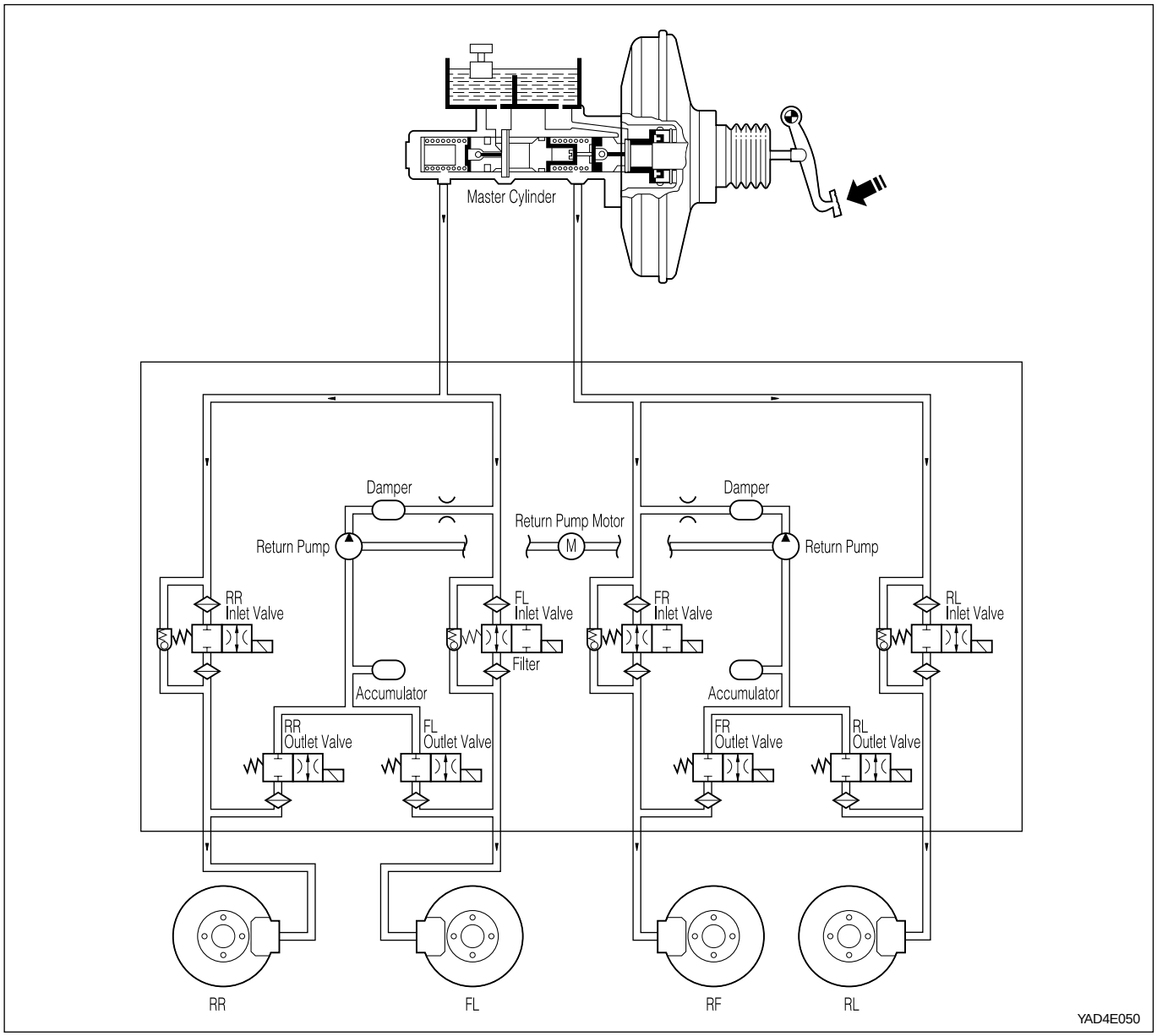
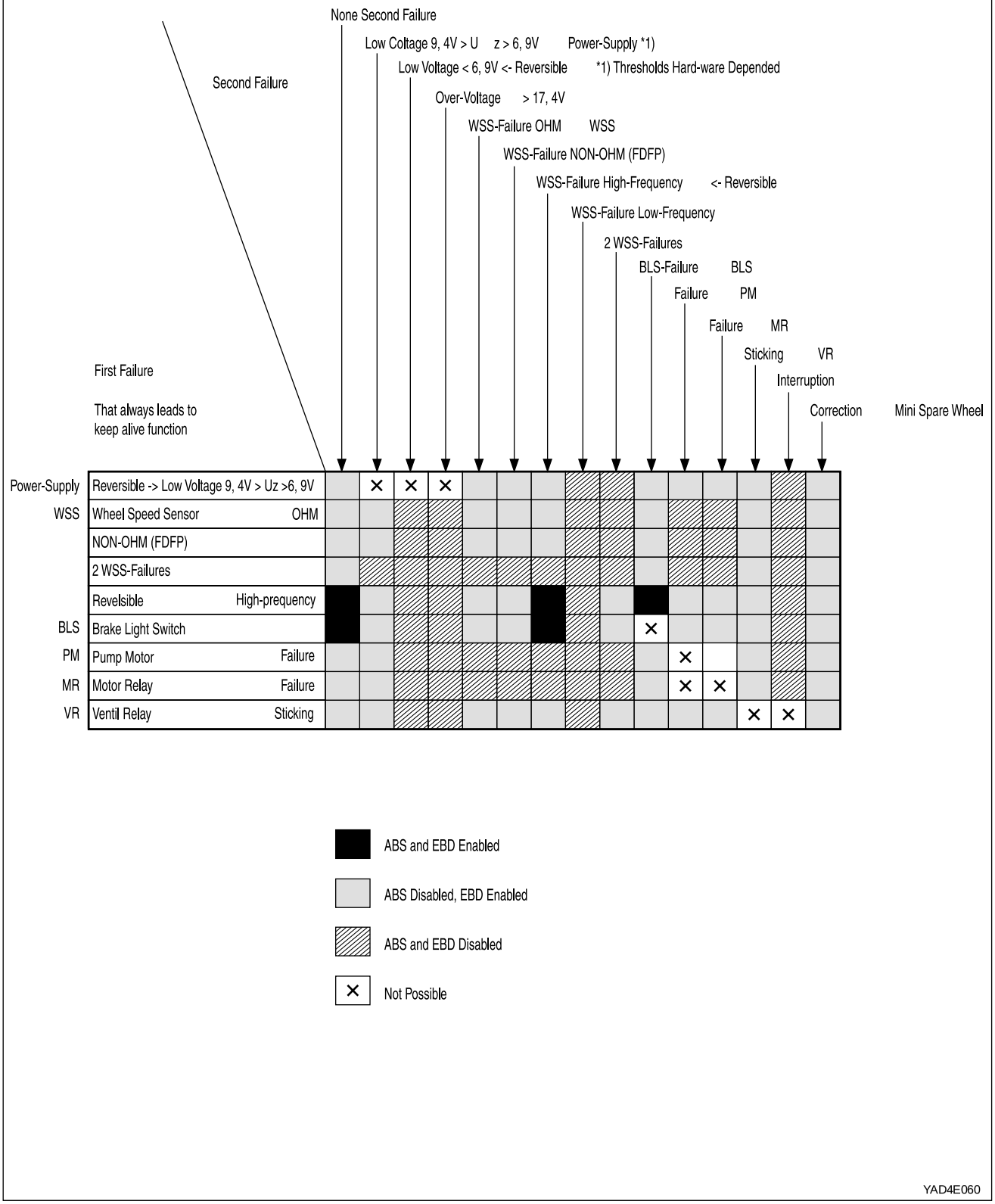
## Hydraulic Fluid Flow Diagrams

For normal brake mode, during non-antilock braking, pressure is applied through the brake pedal and fluid comes from the master cylinder into the hydraulic unit. The normally open isolation cartridge and normally closed dump cartridge would remain in these positions to allow fluid pressure to the calipers and the wheel cylinders. And each wheel begins locking.



## Electronic Brake-Force Distribution (EBD) Failure Matrix For Malfunction



# TIRES AND ABS/TCS

## Replacement Tires

Tire size is important for proper performance of the ABS system. Replacement tires should be the same size, load range, and construction as the original tires. Replace tires in axle sets and only with tires of the same tire performance criteria (TPC) specification number.

The use of any other size or type of tire may seriously affect the ABS operation.

## Electronic Brake Control Module (EBCM)

**Notice:** There is on serviceable or removable EEPROM. The EBCM must be replaced as an assembly (Only ABS). ABS/TCS is separated hydraulic modulator and EBCM.

The EBCM is attached to the hydraulic unit in the engine compartment (ABS). The controlling element of ABS 5.3 is a microprocessor-based EBCM. Inputs to the system include the four wheel speed sensors, the stoplamp switch, the ignition switch, and the unswitched battery voltage. There is an output to a be-directional serial data link, located in pin K of Assembly Line Diagnostic Link (ALDL) for service diagnostic tools and assembly plant testing.

The EBCM monitors the speed of each wheel. If any wheel begins to approach lockup and the brake switch is closed (brake pedal pressed), the EBCM controls the solenoids to reduce brake pressure to the wheel approaching lockup. Once the wheel regains traction, brake pressure is increased until the wheel again begins to approach lockup. This cycle repeats until either the vehicle comes to a stop, the brake pedal is released, or no wheels approach lockup.

Additionally, the EBCM monitors itself, each input (except the serial data link), and each output for proper operation. If it detects any system malfunction, the EBCM will store a DTC in nonvolatile memory (EERPOM) (DTCs will not disappear if the battery is disconnected). Refer to “Self Diagnostics” in this section for more detailed information.

## Front Wheel Speed Sensors

The front wheel speed sensors are of a variable reluctance type. Sensor is attached to the steering knuckle, close to a toothed ring. The result, as teeth pass by the sensor, is an AC voltage with a frequency proportional to the speed of the wheel. The magnitude of the voltage and frequency increase with increasing speed. The sensor is not repairable, nor is the air gap adjustable.

## Front Wheel Speed Sensor Rings

The toothed ring mentioned above is pressed onto the wheel-side (outer) constant velocity joint. Each ring contains 52 equally spaced teeth. Exercise care during service procedures to avoid prying or contacting this ring. Excessive contact may cause damage to one or more teeth. If the ring is damaged, the wheel-side constant velocity joint must be replaced.

## Rear Wheel Speed Sensors And Rings

The rear wheel speed sensors operate in the same manner as the front wheel speed sensor. They incorporate a length of flexible harness with the connector attached to the end of the harness. The rear wheel speed rings are incorporated into the hub assemblies and cannot be replaced separately, require replacement of the rear hub/bearing assembly.

## Valve Realy And Pump Motor Relay

The valve relay and the motor pump relay are located inside the electronic brake control module (EBCM) and are not replaceable. If one should fail, replace the EBCM.

## Wiring Harness

The wiring harness is the mechanism by which the electronic brake control module (EBCM) is electrically connected to power and to ground, to the wheel speed sensors, the fuses, the switches, the indicators, and the serial communications port. The components, considered part of the wiring harness, are the wires that provide electrical interconnection, and connectors (terminals, pins, contacts, or lugs) that provide an electrical/mechanical interface from the wire to a system component.

## Indicators

The electronic brake control module (EBCM) continuously monitors itself and the other ABS components If the EBCM detects a problem with the system, the amber ABS indicator will light continuously to alert the driver to the problem. An illuminated ABS indicator indicates that the ABS system has detected a problem that affects the operation of ABS. On antilock braking will be available. Normal, non-antilock brake performance will remain. In order to regain ABS braking ability, the ABS must be serviced.

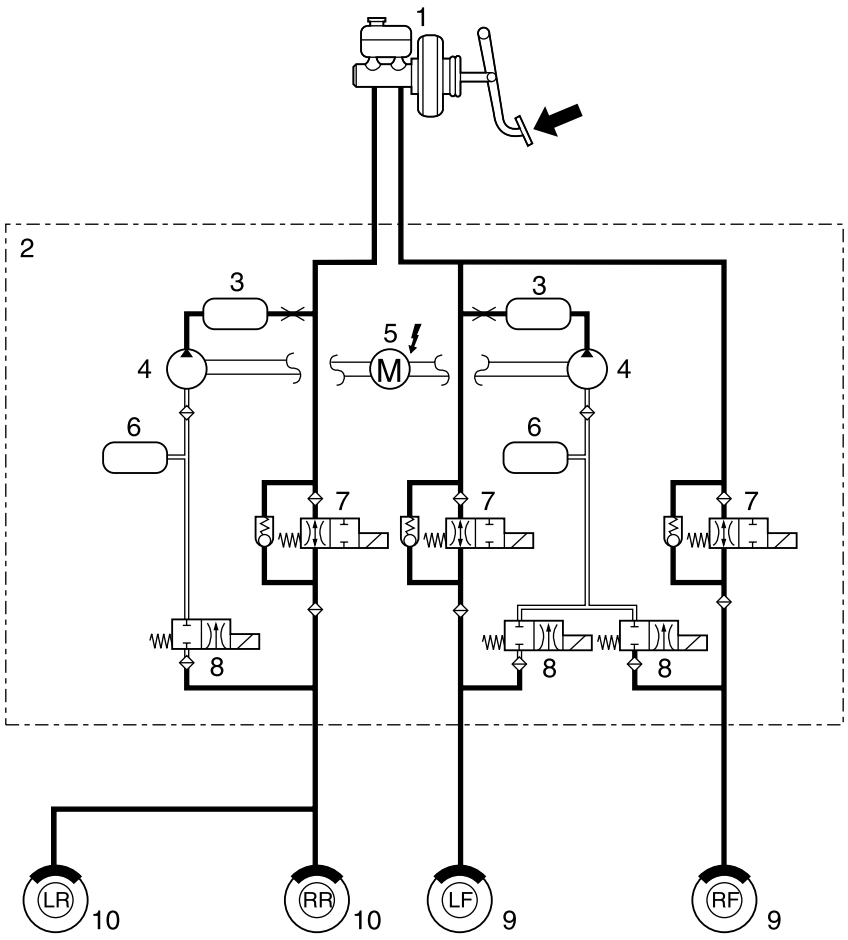
The red BRAKE indicator will be illuminated when the system detects a low brake fluid level in the master cylinder or when the parking brake switch is closed (the parking brake is engaged).

The EBD indicator will light continuously to alert the driver to the problem in the basic brake system. The EBD system must be serviced.

# HYDRAULIC CIRCUIT

## ABS 5.3

### Pressure Increase

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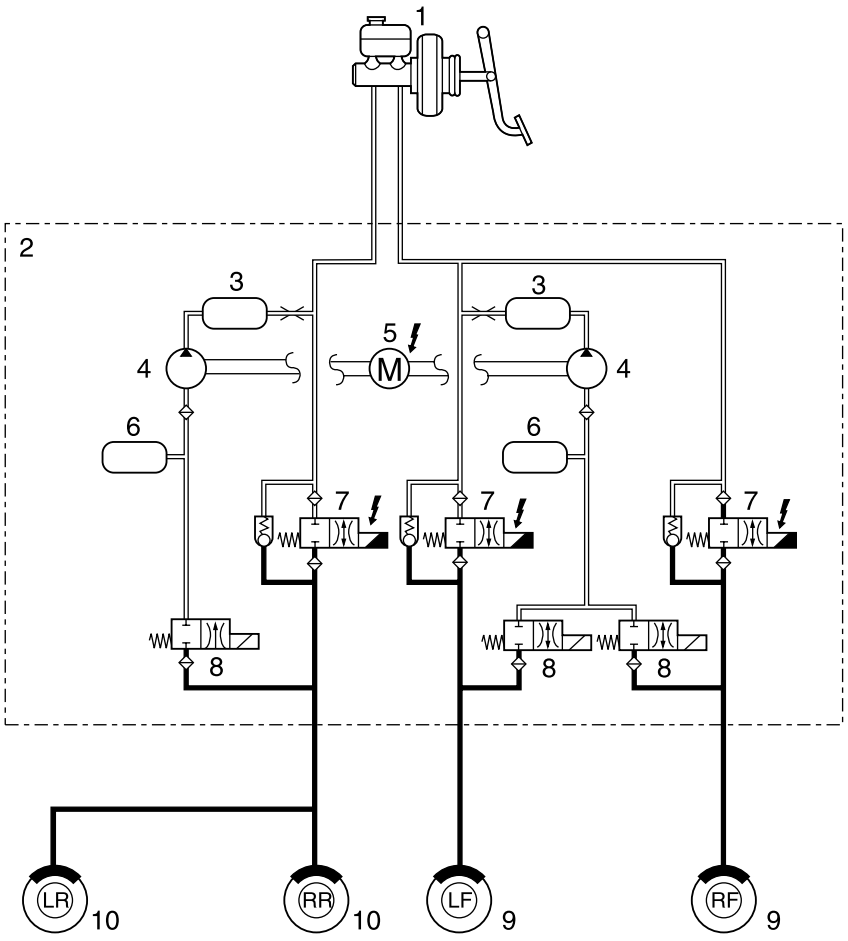
1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Front Wheel
10 Rear Wheel

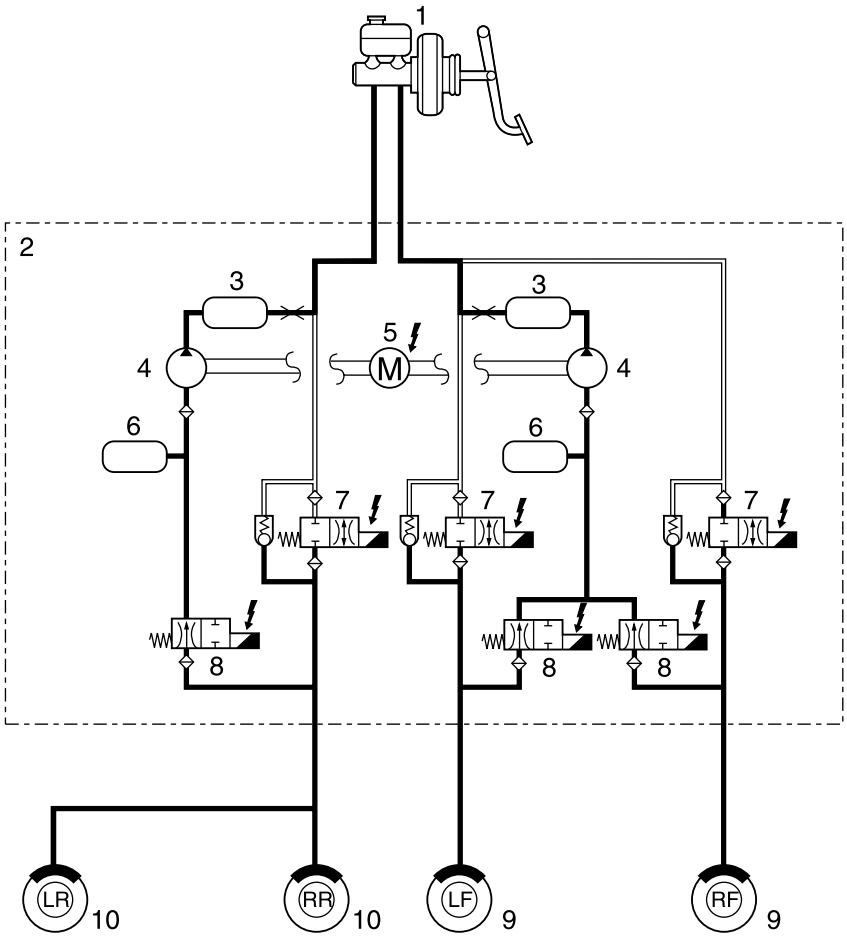
## Pressure Hold




YAD4E080

1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Front Wheel
10 Rear Wheel

## Pressure Decrease

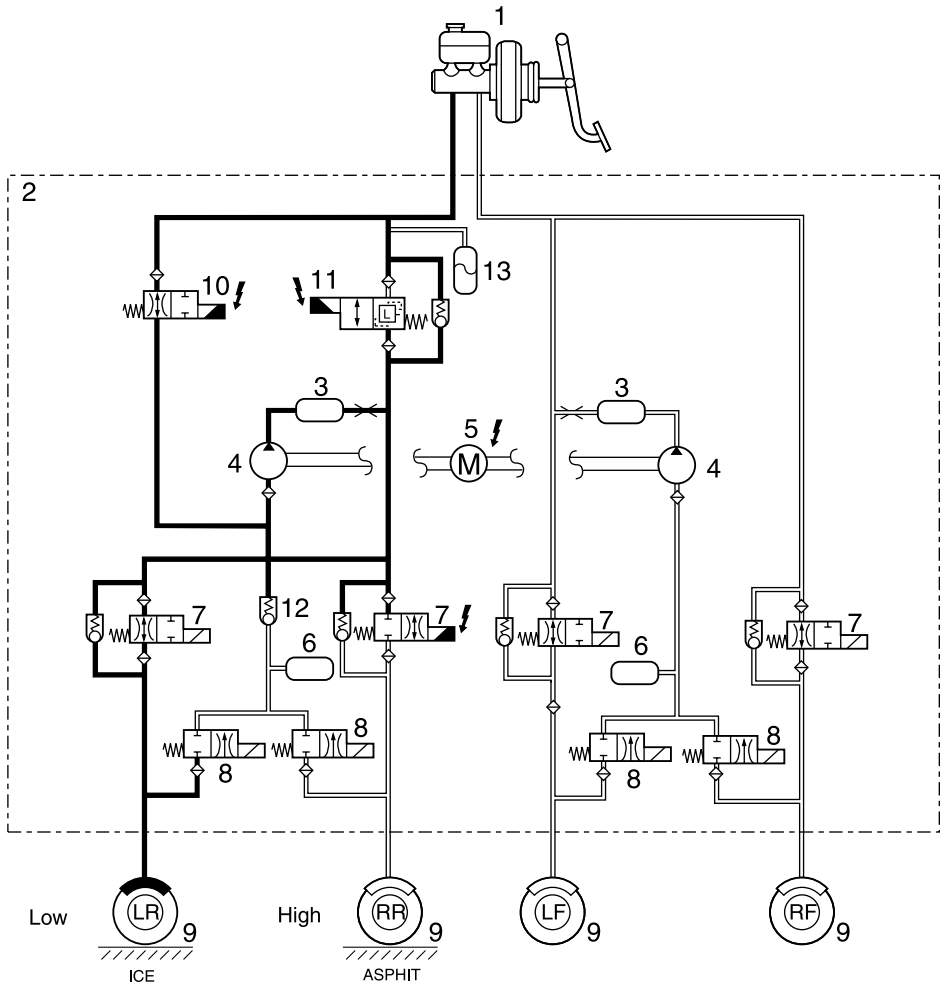



YAD4E090

1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Front Wheel
10 Rear Wheel

# ABS/TCS 5.3

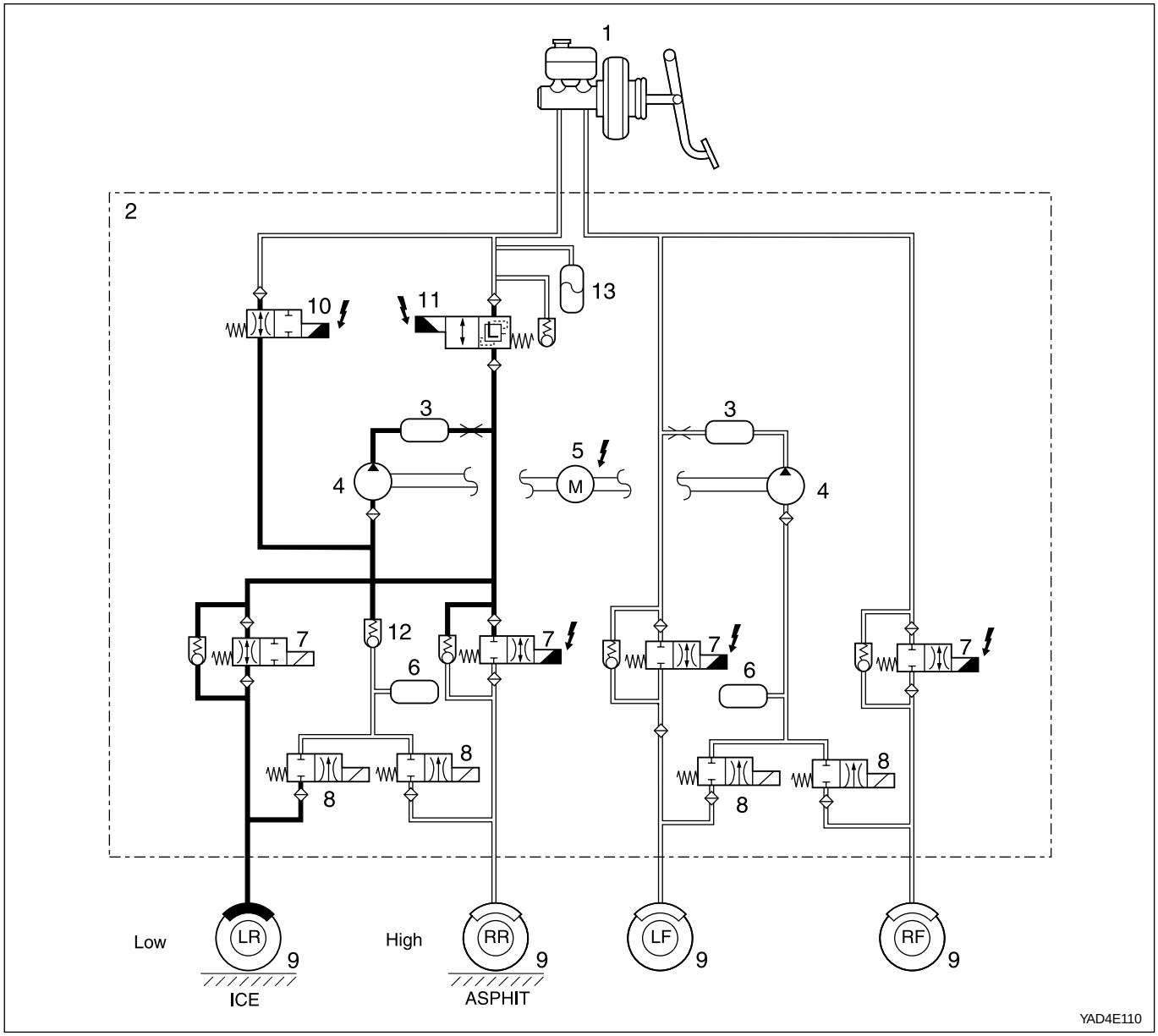
## Pressure Increase




YAD4E100

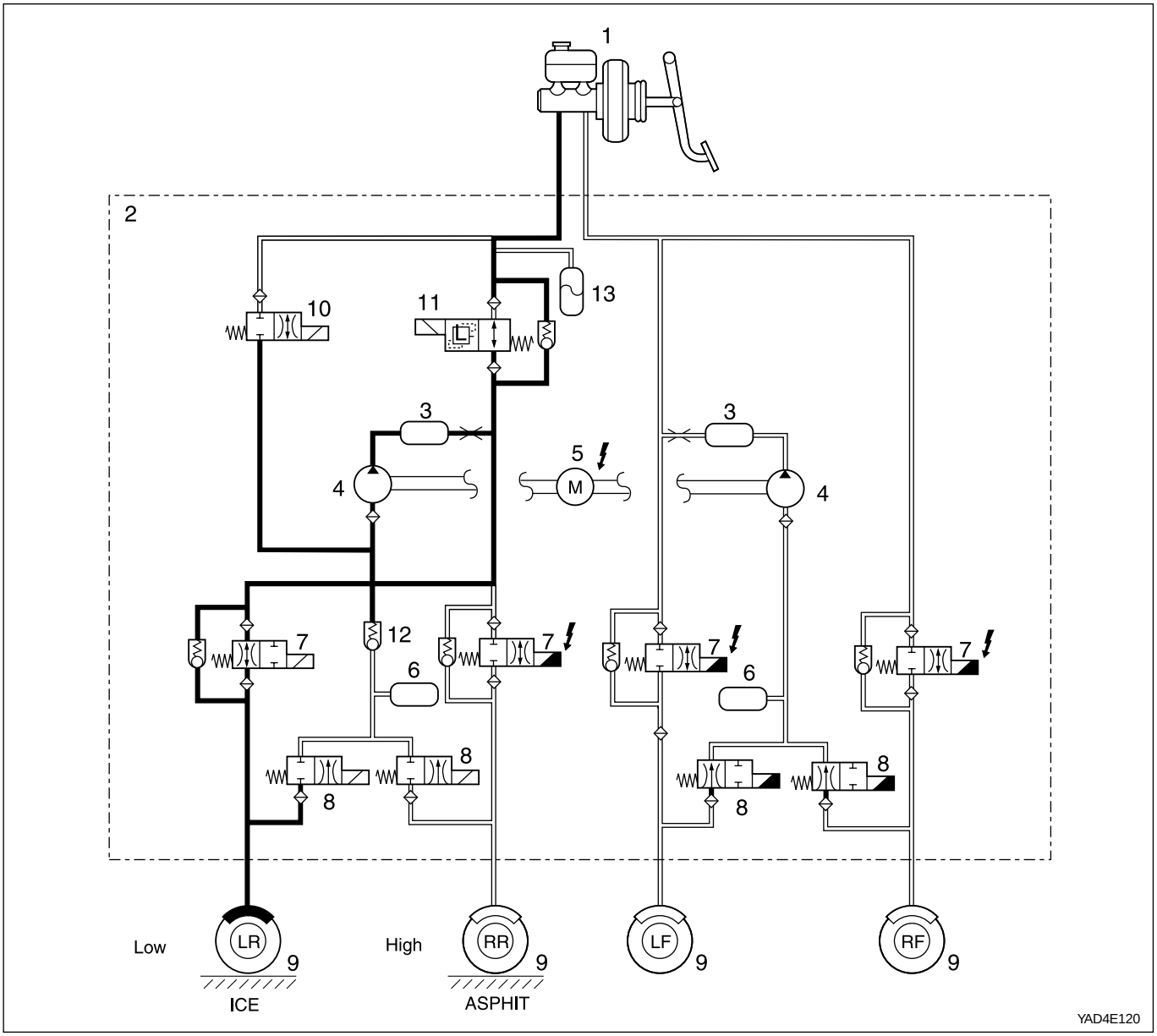
1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Wheel
10 Prime Valve
11 Pilot Valve
12 Check Valve
13 ISD (Integrated Suction Damper)

## Pressure Hold




1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Wheel
10 Prime Valve
11 Pilot Valve
12 Check Valve
13 ISD (Integrated Suction Damper)

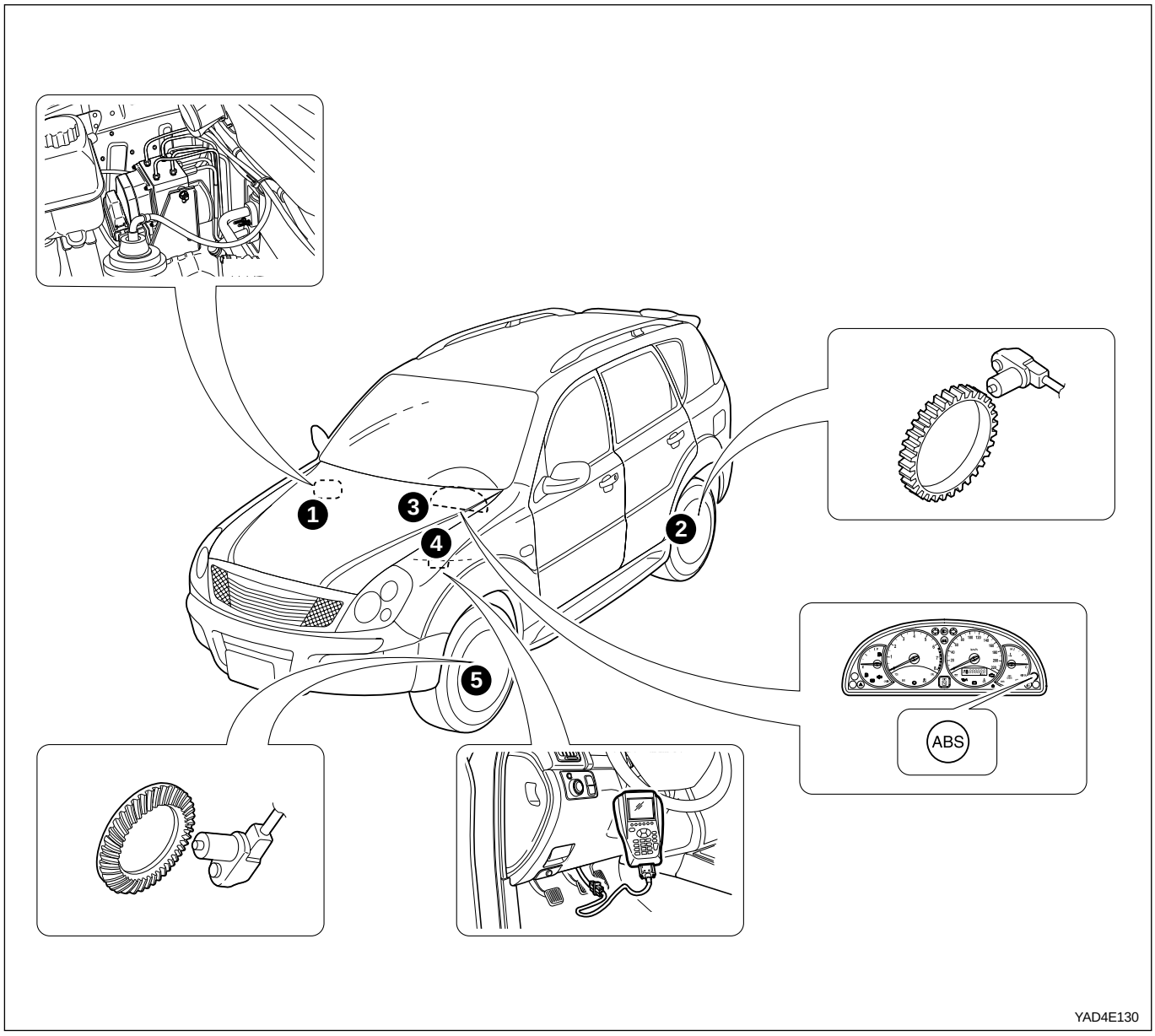
## Pressure Decrease




1 Master Cylinder
2 Hydraulic Modulator
3 Damper
4 Pump
5 Pump Motor
6 Accumulator
7 Inlet Valve for each wheel
8 Outlet Valve for each wheel
9 Wheel
10 Prime Valve
11 Pilot Valve
12 Check Valve
13 ISD (Integrated Suction Damper)

# COMPONENT LOCATOR

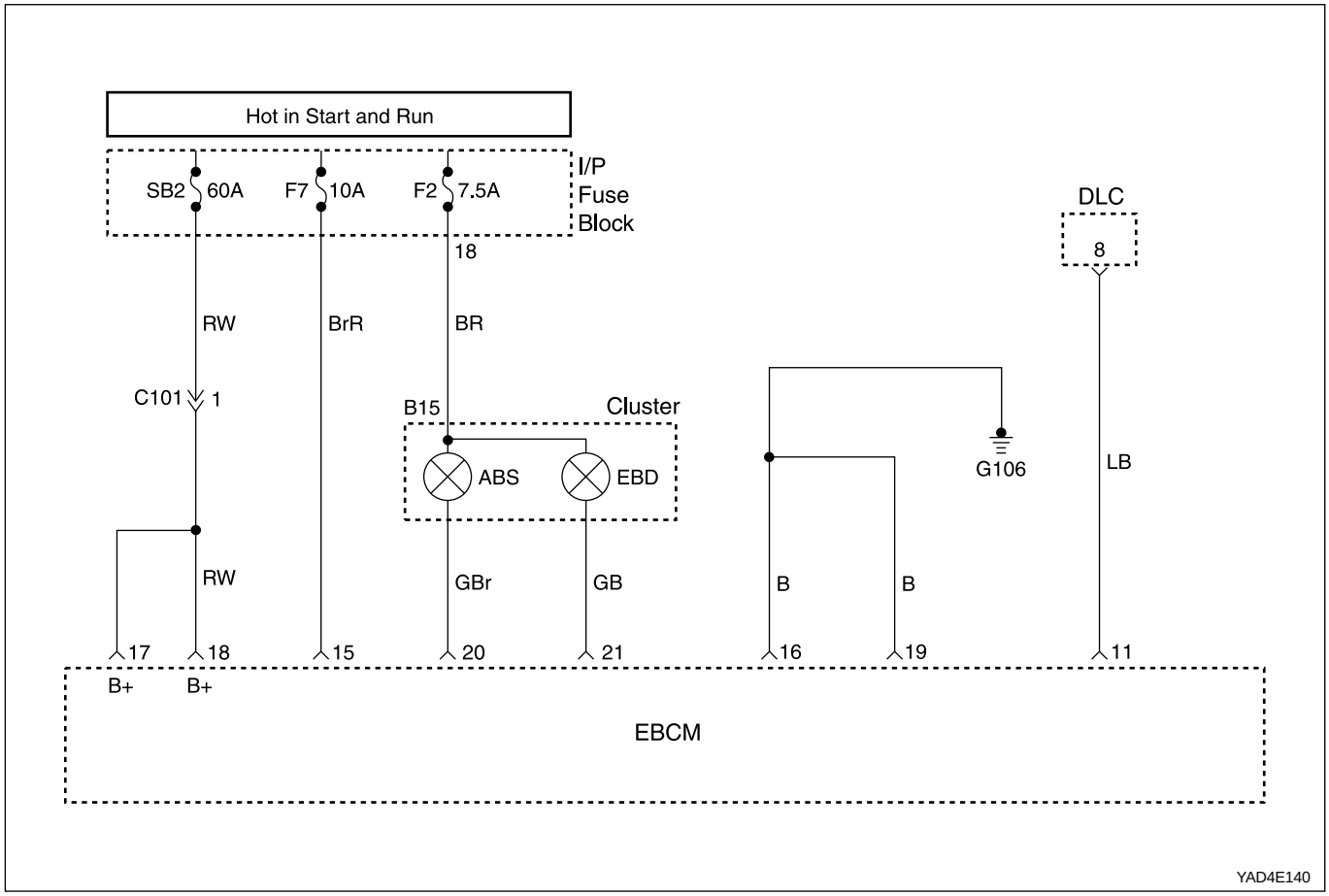
## ABS, ABS/TCS 5.3




1 ABS/TCS Hydraulic Unit and Control Unit
2 Rear Wheel Speed Sensor
3 ABS Warning Indicator
4 Diagnosis connector
5 Front Wheel Speed Sensor

# BLANK

# DIAGNOSTIC INFORMATION AND PROCEDURES




## DIAGNOSTIC CIRCUIT CHECK

The Diagnostic Circuit Check is an organized approach to identifying a problem created by an antilock brake system (ABS) malfunction. If must be the starting point for any ABS complaint diagnosis because it directs the service technician to the next logical step in diagnosing the complaint.

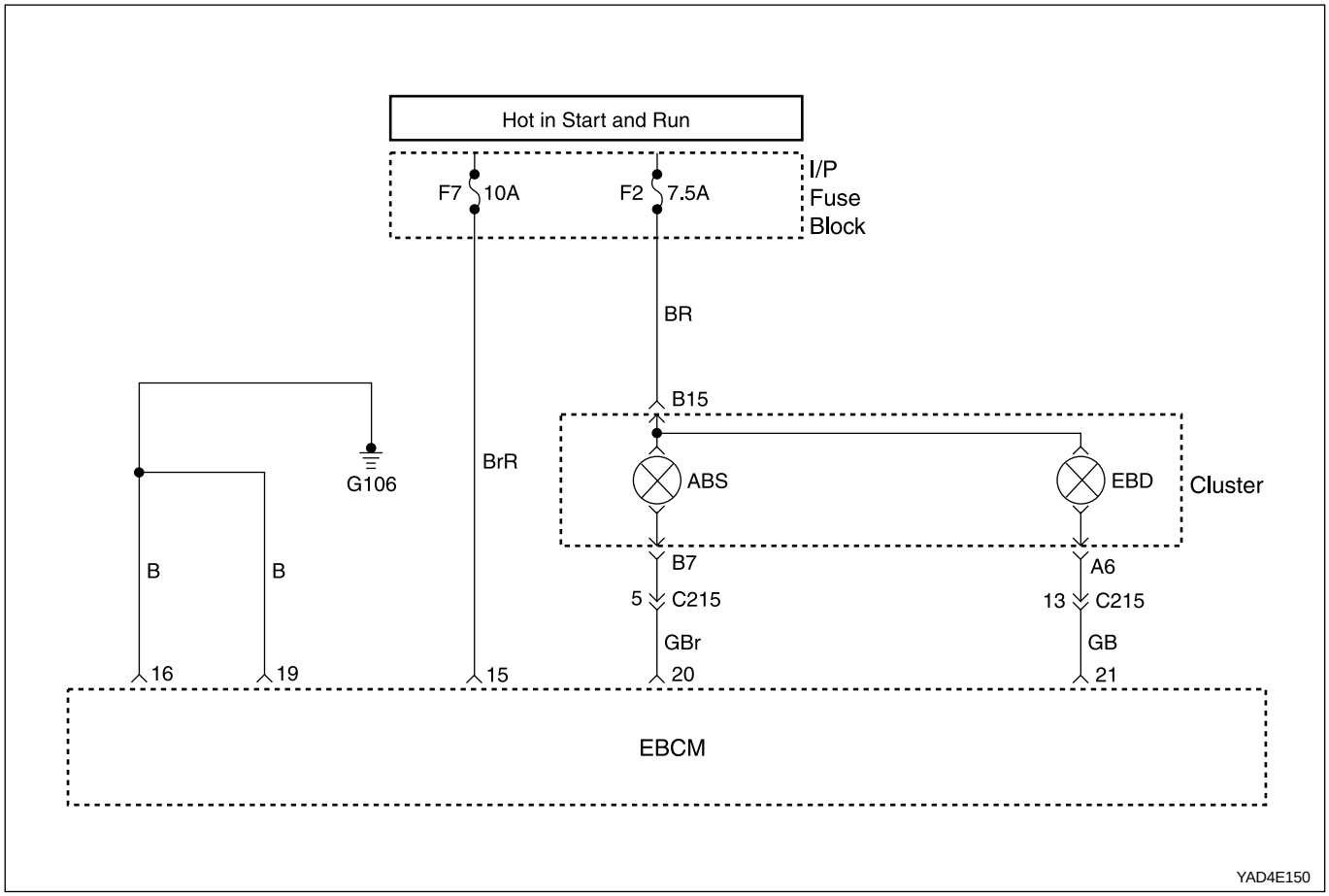
**Diagnostic Process**

Perform the following steps in order when servicing the ABS/TCS system. Failure to do so may result in the loss of important diagnostic data and may lead to difficulties and time-consuming diagnosis procedures.

1. Perform the tests of the table below.
2. Perform a road test if directed by the table.
   - Test drive the vehicle while using the snapshot feature of the scan tool.
   - Perform normal acceleration, stopping, and turning maneuvers.
   - If this does not reproduce the malfunction, perform an ABS stop or TCS maneuver on a low friction surface such as gravel.
3. Clear the diagnostic trouble codes (DTCs) after all system malfunctions have been corrected.

## Diagnostic Circuit Check

| Step | Action | Value | Yes | No |
|---|---|---|---|---|
| 1 | 1. Install the scan tool.<br>2. Turn ignition switch to ON.<br>3. Select the Data List mode.<br>Is the scan tool receiving data from the electronic brake control module (EBCM)? | - | Go to Step 2 | Go to Step 7 |
| 2 | Check the display.<br>Are there any current DTCs displayed? | - | Refer to the applicable DTC table | Go to Step 3 |
| 3 | 1. Turn the ignition to LOCK for 10 seconds.<br>2. Turn the ignition to On and observe the ABS indicator.<br>Does the indicator light for 2 seconds and then go off? | - | Go to Step 5 | Go to Step 4 |
| 4 | Check the ABS indicator.<br>Did the ABS indicator turn on and stay on? | - | Go to “ABS Indicator Lamp Illuminated Constantly” | Go to “ABS Indicator Lamp Inoperative” |
| 5 | Check whether the vehicle is equipped with traction control.<br>Is the vehicle equipped with traction control? | - | Go to Step 6 | Go to Step 13 |
| 6 | 1. Turn the ignition to LOCK for 10 seconds.<br>2. Turn the ignition to ON and observe the TCS indicator.<br>Does the indicator light for 2 seconds and then go off? | - | Go to Step 13 | Go to “TCS Indicator Lamp Inoperative” |
| 7 | 1. Turn the ignition to LOCK.<br>2. Disconnect the EBCM harness connector.<br>3. Turn the ignition to ON.<br>4. Use a digital voltmeter (DVM) to measure the voltage from ground to terminal 15 of the EBCM harness connector.<br>Is the voltage equal to the specified valve? | 11 - 14 V | Go to Step 8 | Go to “Power Supply to Control Module, No DTCs Stored” |
| 8 | 1. Turn the ignition to LOCK.<br>2. Use a DVM to measure the resistance from the EBCM harness connector, terminals 16 and 19 to ground.<br>Is the resistance equal to the specified value? | ≈ 0 Ω | Go to Step 10 | Go to Step 9 |
| 9 | Repair the open in the circuit that failed.<br>Is the repair complete? | - | System OK | - |
| 10 | Use a DVM to measure the resistance between terminal 11 of the EBCM harness connector and terminal 8 of the data link connector (DLC).<br>Is the resistance below the specified valve? | 2 Ω | Go to Step 11 | Go to Step 12 |
| 11 | Replace the ABS unit.<br>Is the repair complete? | - | System OK | - |
| 12 | Repair the open or high resistance in circuit between terminal 11 of the EBCM harness connector and terminal 8 of the DLC.<br>Is the repair complete? | - | Go to Step 1 | - |
| 13 | Perform the road test described above.<br>Are any DTC set? | - | Go to the DTC table | System OK |




# ABS INDICATOR LAMP INOPERATIVE

### Circuit Description

Battery voltage is supplied to the ABS lamp with the ignition switch in the ON or START positions. The warning lamp can be activated only by the ABS control module internally supplying ground to terminal 20 or by the shorting bar in the ABS module connector if the connector in disconnected from the module.

### Diagnosis

This procedure checks for a problem in the wiring, a faulty ground, a voltage supply problem, a burned out indicator lamp, or a contact problem in a connector.

### Cause

- A fuse has blown.
- The indicator lamp has burned out.
- There is a corroded or broken connector terminal.
- There is a faulty ground connection.
- There is a broken wire in a wring harness.
- The EBCM is faulty.

### Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test checks for any DTCs that may cause the ABS indicator lamp to be inoperative.
2. This test verifies an inoperative lamp condition.
3. This test checks for voltage on the lamp circuit.
4. This begins a series of tests of the circuit from the indicator lamp to the EBCM and ground.

19. This begins a series of tests of the voltage supply circuits that power the indicator lamp.

## ABS Indicator Lamp Inoperative

| Step | Action | Value | Yes | No |
|---|---|---|---|---|
| 1 | Install the scan tool and check for any DTCs.<br>Is any DTC set? | - | Go to the DTC table | Go to Step 2 |
| 2 | 1. Turn the ignition to LOCK.<br>2. Disconnect the scan tool.<br>3. Turn the ignition to ON.<br>4. Observe the ABS indicator lamp.<br>Does the lamp illuminate for about 2 seconds, then turn off? | - | Go to “Intermittent and Poor Connections” | Go to Step 3 |
| 3 | With the ignition still ON, observe the oil pressure lamp.<br>Is the oil pressure lamp illuminated? | - | Go to Step 4 | Go to Step 19 |
| 4 | 1. Turn the ignition to LOCK.<br>2. Disconnect the connector from the electronic brake control module (EBCM).<br>3. Turn the ignition switch to ON.<br>Does the ABS indicator illuminate? | - | Go to Step 5 | Go to Step 8 |
| 5 | 1. Turn the ignition to LOCK.<br>2. Examine terminals 16 and 20 at the EBCM connector on both the ABS wiring harness and on the EBCM.<br>Is there a poor connection at any of these terminals? | - | Go to Step 6 | Go to Step 7 |
| 6 | Repair the faulty terminals or replace the ABS unit, as required.<br>Is the repair complete? | - | System OK | - |
| 7 | Replace the ABS unit.<br>Is the repair complete? | - | System OK | - |
| 8 | 1. Turn the ignition to LOCK.<br>2. Disconnect the wire from the negative battery terminal.<br>3. Measure the resistance between the negative battery wire, which is attached to ground, and the shorting bar in the EBCM connector.<br>Is the resistance equal to the specified valve? | ≈ 0 Ω | Go to Step 10 | Go to Step 9 |
| 9 | Repair the open or high resistance in the circuit from EBCM connector, terminal 16 to ground G106.<br>Is the repair complete? | - | System OK | - |
| 10 | 1. Remove the I/P cluster.<br>2. Remove and check the ABS indicator bulb.<br>Is the bulb burned out? | - | Go to Step 11 | Go to Step 12 |
| 11 | 1. Replace the ABS indicator bulb.<br>2. Install the I/P cluster.<br>Is the repair complete? | - | System OK | - |
| 12 | Check the continuity at the I/P cluster connector terminal B7.<br>Is the continuity equal to the specified value? | ≈ 0 Ω | Go to Step 14 | Go to Step 13 |
| 13 | Repair the contact at the I/P cluster connector terminal B7.<br>Is the repair complete? | - | System OK | - |

## ABS Indicator Lamp Inoperative (Cont'd)

| Step | Action | Value | Yes | No |
|---|---|---|---|---|
| 14 | Check the wiring harnesses and the connectors in circuit from the I/P cluster terminal B7 to terminal 20 of the EBCM connector.<br>Is the voltage equal to the specified value? | ∞ | Go to Step 15 | Go to Step 16 |
| 15 | Repair the open or the resistance found.<br>Is the repair complete? | - | System OK | - |
| 16 | Check for continuity between terminal 16 of the EBCM connector and ground G106.<br>Is the continuity equal to the specified value? | ≈ 0 Ω | Go to Step 10 | Go to Step 9 |
| 17 | Replace the ABS unit.<br>Is the repair complete? | - | System OK | - |
| 18 | Repair the continuity problem between terminal 16 of the EBCM connector and ground G106.<br>Is the repair complete? | - | System OK | - |
| 19 | 1. Turn the ignition to LOCK.<br>2. Check fuse F2 in the I/P fuse block.<br>Is fuse F2 blown? | - | Go to Step 20 | Go to Step 21 |
| 20 | Replace fuse F2.<br>Is the repair complete? | - | System OK | - |
| 21 | 1. Turn the ignition on.<br>2. Check the voltage at Fuse 2.<br>Is the voltage equal to the specified value? | 11 - 14 V | Go to Step 22 | Go to Step 21 |
| 22 | Repair the power supply to Fuse 2.<br>Is the repair complete? | - | System OK | - |
| 23 | 1. Remove the instrument cluster.<br>2. Check the circuit from fuse F2 to terminal B15 of the I/P cluster connector.<br>3. Repair any open or high resistance found in a wiring harness, splice pack, or connector.<br>Is the repair complete? | - | System OK | - |

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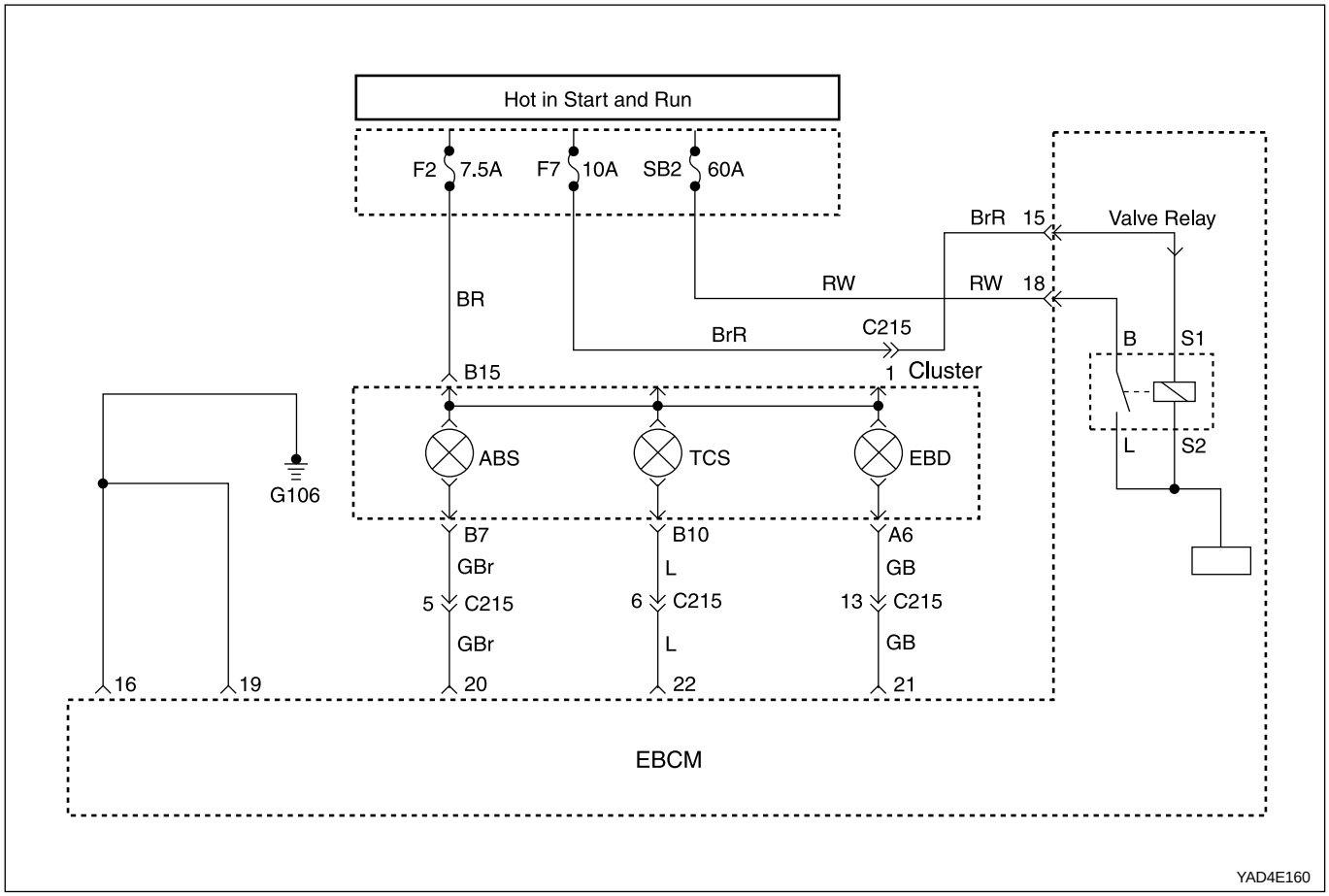


# TRACTION CONTROL SYSTEM (TCS) INDICATOR LAMP INOPERATIVE

### Circuit Description

Battery voltage is supplied to the TCS warning lamp with the ignition in ON or START. The warning lamp can be activated only by the ABS control module internally supplying ground to terminal 22.

### Diagnosis

This procedure checks for a problem in the wiring, a faulty ground, a voltage supply problem, a burned out indicator lamp, or a contact problem in a connector.

### Cause

- A fuse has blown.
- The indicator lamp has burned out.
- There is a corroded or broken connector terminal.
- There is a faulty ground connection.
- There is a broken wire in a wiring harness.
- The EBCM is faulty.

### Test description

The number(s) below refer to step(s) on the diagnostic table.

1. This test checks for any DTCs that may cause the TCS indicator lamp to be inoperative.
2. This test verifies an inoperative lamp condition.
3. This test checks for voltage on the lamp circuit.
4. This begins a series of tests of the circuit from the indicator lamp to the EBCM and ground.

19. This begins a series of tests of the voltage supply circuits that power the indicator lamp.

## Traction Control System (TCS) Indicator Lamp Inoperative

| Step | Action | Value | Yes | No |
|---|---|---|---|---|
| 1 | Install the scan tool and check for any DTCs.<br>Is any DTC set? | - | Go to the DTC table | Go to Step 2 |
| 2 | 1. Turn the ignition to LOCK.<br>2. Disconnect the scan tool.<br>3. Turn the ignition to ON.<br>4. Observe the TCS indicator lamp.<br>Does the lamp illuminate for about 2 seconds, then turn off? | - | Go to “Intermittent and Poor Connections” | Go to Step 3 |
| 3 | With the ignition still ON, observe the oil pressure lamp.<br>Is the oil pressure lamp illuminated? | - | Go to Step 4 | Go to Step 19 |
| 4 | 1. Turn the ignition to LOCK.<br>2. Disconnect the connector from the EBCM.<br>3. Connect a jumper form terminal 22 to the grounding bar in the connector.<br>4. Turn the ignition to ON.<br>Does the TCS indicator illuminate? | - | Go to Step 5 | Go to Step 8 |
| 5 | 1. Turn the ignition to LOCK.<br>2. Examine terminals 16, 19 at the EBCM connector on both the ABS wiring harness and on the EBCM.<br>Is there a poor connection at any of these terminals? | - | Go to Step 6 | Go to Step 7 |
| 6 | Repair the faulty terminals or replace the ABS unit, as required.<br>Is the repair complete? | - | System OK | - |
| 7 | Replace the ABS unit.<br>Is the repair complete? | - | System OK | - |
| 8 | 1. Turn the ignition to LOCK.<br>2. Disconnect the wire from the negative battery terminal.<br>3. Measure the resistance between the negative battery wire, which is attached to ground, and the shorting bar in the EBCM connector.<br>Is the resistance equal to the specified value? | ≈ 0 Ω | Go to Step 10 | Go to Step 9 |
| 9 | Repair the open or high resistance in the circuit from EBCM connector, terminal 16, 19 to ground G106.<br>Is the repair complete? | - | System OK | - |
| 10 | 1. Remove the I/P cluster.<br>2. Remove and check the TCS indicator bulb.<br>Is the bulb burned out? | - | Go to Step 11 | Go to Step 12 |
| 11 | 1. Replace the TCS indicator bulb.<br>2. Replace the I/P cluster.<br>Is the repair complete? | - | System OK | - |
| 12 | Check continuity at the I/P cluster connector terminal B10.<br>Is the continuity equal to the specified value? | ≈ 0 Ω | Go to Step 14 | Go to Step 13 |
| 13 | Repair the contact at the I/P cluster connector terminal B10.<br>Is the repair complete? | - | System OK | - |

## Traction Control System (TCS) Indicator Lamp Inoperative (Cont'd)

| Step | Action | Value | Yes | No |
|---|---|---|---|---|
| 14 | Check the wiring harnesses and connectors in circuit from the I/P cluster terminal B10 to terminal 22 of the EBCM connector.<br>Is the voltage equal to the specified value? | 0 Ω | Go to Step 15 | Go to Step 16 |
| 15 | Repair the open or high resistance.<br>Is the repair complete? | - | System OK | - |
| 16 | Check for continuity between terminal 16, 19 of the ABS connector and ground G106.<br>Is the continuity equal to the specified value? | 0 Ω | Go to Step 17 | Go to Step 18 |
| 17 | Replace the ABS unit.<br>Is the repair complete? | - | System OK | - |
| 18 | Repair the continuity between terminal 16, 19 of the EBCM connector and ground G106.<br>Is the repair complete? | - | System OK | - |
| 19 | 1. Turn the ignition to LOCK.<br>2. Check fuse F2 in the I/P fuse block.<br>Is fuse F2 blown? | - | Go to Step 20 | Go to Step 21 |
| 20 | Replace fuse F2.<br>Is the repair complete? | - | System OK | - |
| 21 | 1. Turn the ignition ON.<br>2. Check the voltage at fuse F2.<br>Is the voltage equal to the specifies value? | 11 - 14 V | Go to Step 22 | Go to Step 23 |
| 22 | Repair the power supply to fuse F2.<br>Is the repair complete? | - | System OK | - |
| 23 | 1. Remove the I/P cluster.<br>2. Check circuit from fuse F2 to terminal 15 of the I/P cluster connector.<br>3. Repair any open or high resistance found in a wiring harness, a splice pack, or a connector.<br>Is the repair complete? | - | System OK | - |

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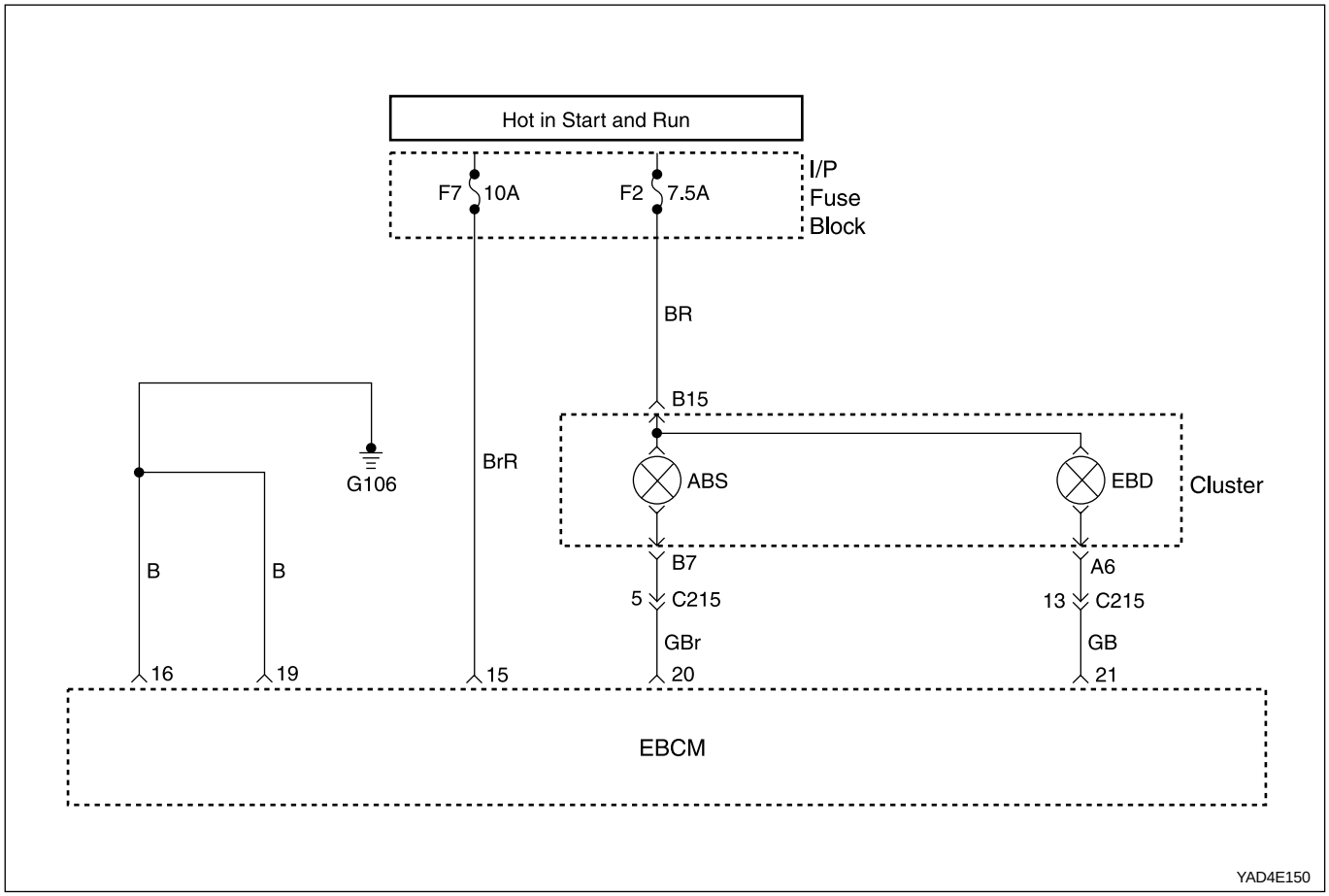


# ELECTRONIC BRAKE-FORCE DISTRIBUTION SYSTEM (EBD) INDICATOR LAMP INOPERATIVE

### Circuit Description

Battery voltage is supplied to the EBD warning lamp with the ignition in ON or START. The warning lamp can be activated only by the ABS control module internally supplying ground to terminal 21.

### Diagnosis

This procedure checks for a problem in the wiring, a faulty ground, a voltage supply problem, a burned out indicator lamp, or a contact problem in a connector.

### Cause

- A fuse has blown.
- The indicator lamp has burned out.
- There is a corroded or broken connector terminal.
- There is a faulty ground connection.
- There is a broken wire in a wiring harness.
- The EBCM is faulty.

### Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This test checks for any DTCs that may cause the EBD indicator lamp to be inoperative.
2. This test verifies an inoperative lamp condition.
3. This test checks for voltage on the lamp circuit.
4. This begins a series of tests of the circuit from the indicator lamp to the EBCM and ground.

19. This begins a series of tests of the voltage supply circuits that power the indicator lamp.

## Electronic Brake-Force Distribution System (EBD) Indicator Lamp Inoperative

| Step | Action | Value | Yes | No |
|---|---|---|---|---|
| 1 | Install the scan tool and check for any DTCs.<br>Is any DTC set? | - | Go to the DTC table | Go to Step 2 |
| 2 | 1. Turn the ignition to LOCK.<br>2. Disconnect the scan tool.<br>3. Turn the ignition to ON.<br>4. Observe the EBD indicator lamp<br>Does the lamp illuminate for about 2 seconds, then turn off? | - | Go to “Intermittent and Poor Connections” | Go to Step 3 |
| 3 | With the ignition still ON, observe the oil pressure lamp.<br>Is the oil pressure lamp illuminated? | - | Go to Step 4 | Go to Step 19 |
| 4 | 1. Turn the ignition to LOCK.<br>2. Disconnect the connector from the EBCM.<br>3. Connect a jumper form terminal 16, 19 to the grounding bar in the connector.<br>4. Turn the ignition to ON.<br>Does the EBD indicator illuminate? | - | Go to Step 5 | Go to Step 8 |
| 5 | 1. Turn the ignition to LOCK.<br>2. Examine terminals 16, 19 and 28, 29 at the EBCM connector on both the ABS wiring harness and on the EBCM.<br>Is there a poor connection at any of these terminals? | - | Go to Step 6 | Go to Step 7 |
| 6 | Repair the faulty terminals or replace the ABS unit, as required.<br>Is the repair complete? | - | System OK | - |
| 7 | Replace the ABS unit.<br>Is the repair complete? | - | System OK | - |
| 8 | 1. Turn the ignition to LOCK.<br>2. Disconnect the wire from the negative battery terminal.<br>3. Measure the resistance between the negative battery wire, which is attached to ground, and the shorting bar in the EBCM connector.<br>Is the resistance equal to the specified value? | ≈ 0 Ω | Go to Step 10 | Go to Step 9 |
| 9 | Repair the open or high resistance in the circuit from EBCM connector, terminal 16, 19 to ground G106.<br>Is the repair complete? | - | System OK | - |
| 10 | 1. Remove the I/P cluster.<br>2. Remove and check the EBD indicator bulb.<br>Is the bulb burned out? | - | Go to Step 11 | Go to Step 12 |
| 11 | 1. Replace the EBD indicator bulb.<br>2. Replace the I/P cluster.<br>Is the repair complete? | - | System OK | - |
| 12 | Check continuity at the I/P cluster connector terminal A6.<br>Is the continuity equal to the specified value? | ≈ 0 Ω | Go to Step 14 | Go to Step 13 |
| 13 | Repair the contact at the I/P cluster connector terminal A6.<br>Is the repair complete? | - | System OK | - |

## Electronic Brake-Force Distribution System (EBD) Indicator Lamp Inoperative (Cont'd)

| Step | Action | Value | Yes | No |
|---|---|---|---|---|
| 14 | Check the wiring harnesses and connectors in circuit from the I/P cluster terminal A6 to terminal 21 of the EBCM connector.<br>Is the voltage equal to the specified value? | ∞ | Go to Step 15 | Go to Step 16 |
| 15 | Repair the open or high resistance.<br>Is the repair complete? | - | System OK | - |
| 16 | Check for continuity between terminal 16, 19 of the ABS connector and ground G106.<br>Is the continuity equal to the specified value? | ≈ 0 Ω | Go to Step 17 | Go to Step 18 |
| 17 | Replace the ABS unit.<br>Is the repair complete? | - | System OK | - |
| 18 | Repair the continuity between terminal 16, 19 of the EBCM connector and ground G106.<br>Is the repair complete? | - | System OK | - |
| 19 | 1. Turn the ignition to LOCK.<br>2. Check fuse F2 in the I/P fuse block.<br>Is fuse F2 blown? | - | Go to Step 20 | Go to Step 21 |
| 20 | Replace fuse F2.<br>Is the repair complete? | - | System OK | - |
| 21 | 1. Turn the ignition ON.<br>2. Check the voltage at fuse F2.<br>Is the voltage equal to the specifies value? | 11 - 14 V | Go to Step 22 | Go to Step 23 |
| 22 | Repair the power supply to fuse F2.<br>Is the repair complete? | - | System OK | - |
| 23 | 1. Remove the I/P cluster.<br>2. Check circuit from fuse F2 to terminal 15 of the I/P cluster connector.<br>3. Repair any open or high resistance found in a wiring harness, a splice pack, or a connector.<br>Is the repair complete? | - | System OK | - |

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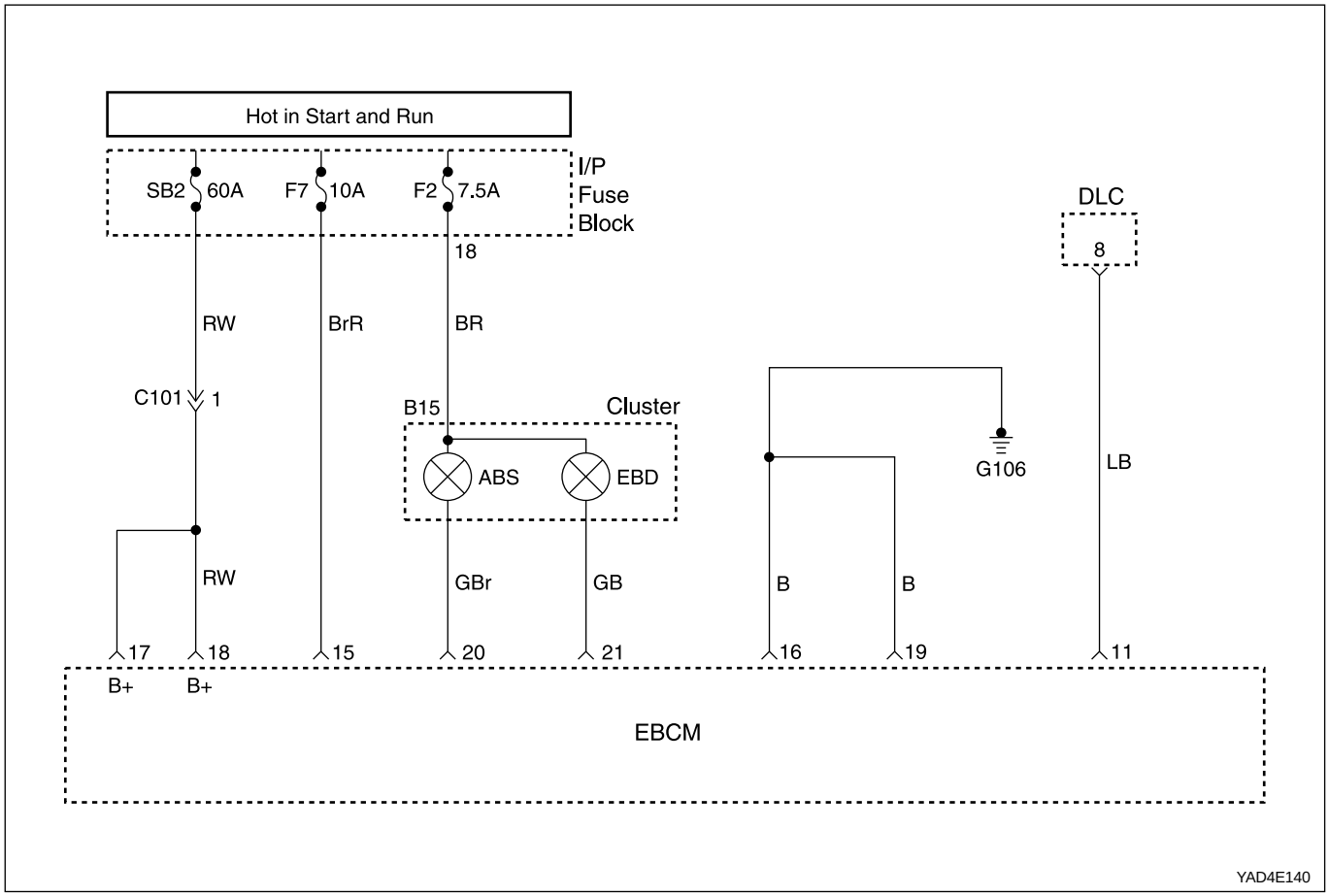


# POWER SUPPLY TO CONTROL MODULE, NO DTCS STORED

### Circuit Description

Battery voltage is supplied to the electronic brake control module (EBCM) through fuse F3 and F2 in the I/P fuse block, to terminal 15 and 20 of the EBCM connector. The voltage is present when the ignition switch is in ON or START.

### Diagnosis

This test checks for battery output, proper grounding, blown fuses, a faulty ignition switch, and problems in the circuitry.

### Cause

- The battery is defective.
- There is a defective ground connection.
- A wire is broken or shorted.
- A fuse is blown.
- The ignition switch is malfunctioning.

### Action Taken When the DTC Sets

ABS action is disabled during the period of low voltage, and the ABS warning lamp is ON for the remainder of the ignition cycle.

### Test Description

The number(s) below refer to step(s) on the diagnostic table.

1. This step determines whether there is voltage at the battery and the high current source.
7. This step checks for voltage at the ignition 1 source.

### Diagnostic Aids

It is very important to perform a thorough inspection of the wiring and the connectors. Failure to do so may result in misdiagnosis, causing part replacement with a reappearance of the malfunction.

## Power Supply to Control Module, No DTCs Stored

| Step | Action | Value | Yes | No |
|---|---|---|---|---|
| 1 | Check the voltage at the battery.<br>Is the voltage equal to the specified value? | 11 - 14 V | Go to Step 3 | Go to Step 2 |
| 2 | Charge or replace the battery, as required.<br>Is the repair complete? | - | System OK | - |
| 3 | Check fuse F7 in the I/P fuse block.<br>Is the fuse blown? | - | Go to Step 4 | Go to Step 8 |
| 4 | 1. Replace fuse F7.<br>2. Turn the ignition to ON.<br>Does the fuse blow again? | - | Go to Step 6 | Go to Step 5 |
| 5 | Check the ABS function.<br>Is the repair complete? | - | System OK | - |
| 6 | 1. Turn the ignition to OFF.<br>2. Remove fuse F7.<br>3. Disconnect the ABS connector from the EBCM.<br>4. Measure the resistance to ground at terminals 15.<br>Does the ohmmeter show the specified value? | ≈ 0 Ω | Go to Step 7 | Go to Step 26 |
| 7 | Repair the short to ground in circuit between F7 and the ABS harness EBCM connector.<br>Is the repair complete? | - | System OK | - |
| 8 | 1. Turn the ignition to ON.<br>2. Check the voltage at fuse F2.<br>Is the voltage equal to the specified value? | 11 - 14 V | Go to Step 10 | Go to Step 9 |
| 9 | Repair the power supply to fuse 2.<br>Is the repair complete? | - | System OK | - |
| 10 | Check fuse F2 in the I/P fuse block.<br>Is the fuse F2 blown? | - | Go to Step 14 | Go to Step 18 |
| 11 | 1. Replace fuse F2.<br>2. Turn the ignition to ON.<br>Does the fuse blow again? | - | Go to Step 13 | Go to Step 12 |
| 12 | Check the ABS function.<br>Is the repair complete? | - | System OK | - |
| 13 | 1. Turn the ignition to OFF.<br>2. Remove fuse F2.<br>3. Disconnect the ABS connector from the EBCM.<br>4. Measure the resistance between ground and terminal 20.<br>Is the resistance equal to the specified value? | ≈ 0 Ω | Go to Step 14 | Go to Step 13 |
| 14 | Repair the short to ground in circuit fuse F2 of the I/P fuse block and terminal 20 of the ABS harness EBCM connector.<br>Is the repair complete? | - | System OK | - |
| 15 | 1. Disconnect the EBCM connector from the EBCM.<br>2. Turn the ignition to ON.<br>3. Check for the presence of battery voltage between ground and terminal 17, 18.<br>Is the voltage equal to the specified value? | 11 - 14 V | Go to Step 10 | Go to Step 9 |

## Power Supply to Control Module, No DTCs Stored (Cont'd)

| Step | Action | Value | Yes | No |
|---|---|---|---|---|
| 16 | 1. Turn the ignition switch to OFF.<br>2. Trace the RW wires between terminal 15 of the EBCM connector to fuse F7 of the I/P fuse block.<br>3. Repair the open in this circuit.<br>Is the repair complete? | - | System OK | - |
| 17 | Check the voltage between ground and terminal 20 of the EBCM connector.<br>Is the voltage equal to the specified value? | 11 - 14 V | Go to Step 19 | Go to Step 18 |
| 18 | 1. Turn the ignition switch to OFF.<br>2. Check the resistance between ground and terminals 16 of the EBCM connector.<br>Is the resistance equal to the specified value? | - | System OK | - |
| 19 | 1. Turn the ignition to OFF<br>2. Check the resistance between ground and terminals 16 of the EBCM connector.<br>Is the resistance equal to the specified value? | ≈ 0 Ω | Go to Step 20 | Go to Step 23 |
| 20 | Examine terminals 15, 20, 16 of the EBCM connector.<br>Is there a defective terminal? | - | Go to Step 21 | Go to Step 22 |
| 21 | Repair the defective terminal or replace the connector or wiring harness, as required.<br>Is the repair complete? | - | System OK | - |
| 22 | Replace the ABS unit.<br>Is the repair complete? | - | System OK | - |
| 23 | Repair the defective ground connection.<br>Is the repair complete? | - | System OK | - |

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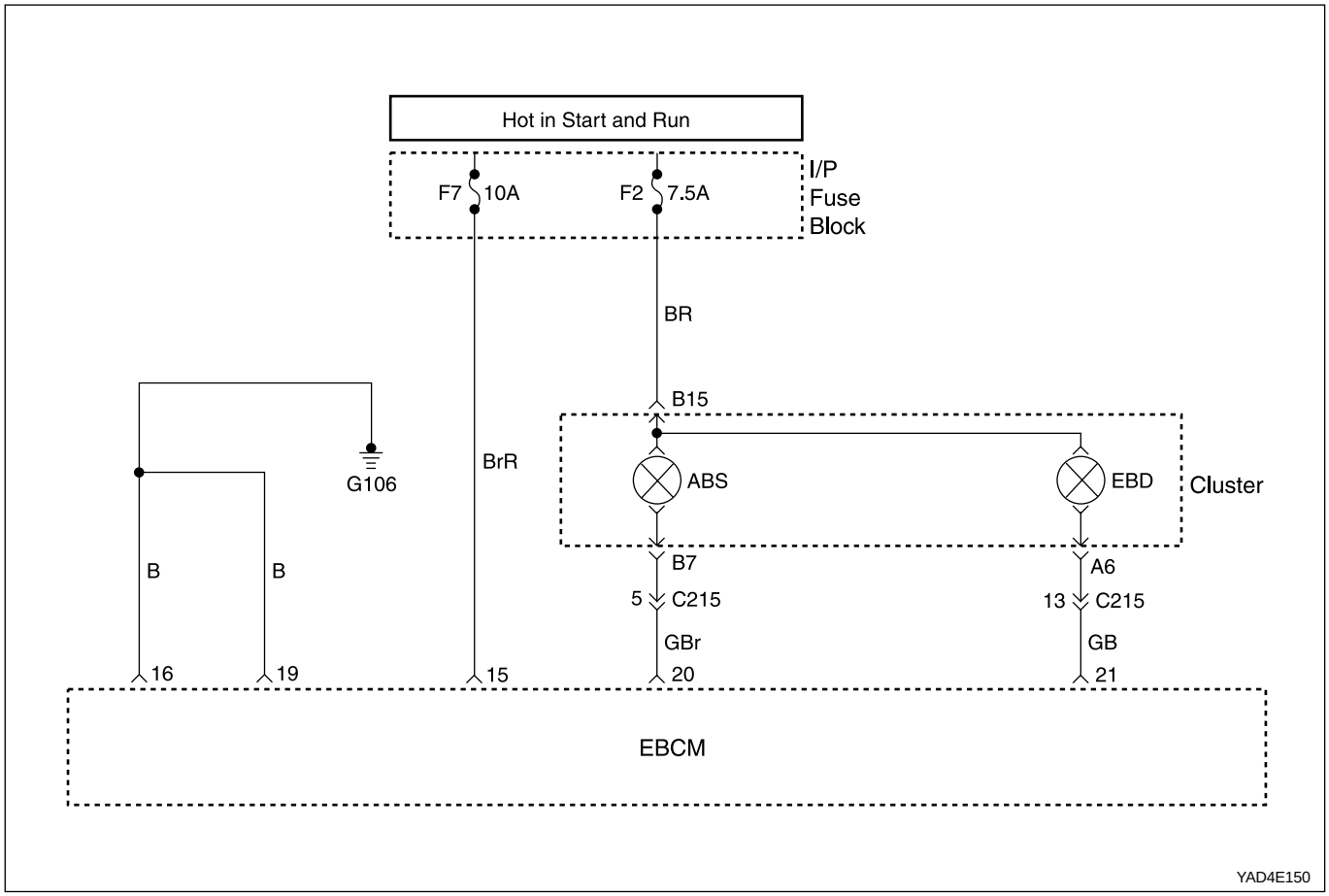


# ABS INDICATOR LAMP ILLUMINATED CONTINUOUSLY, NO DTCS STORED

**Circuit Description**

Battery voltage is supplied to the ABS warning lamp with the ignition in ON or START. The warning lamp should be activated only by the ABS control module internally supplying ground to terminal 20.

**Diagnosis**

This procedure checks for a short to ground in the wiring or a defective electronic brake control module (EBCM).

**Cause**

- There is a short to ground in the circuit between the cluster terminal D7 and the EBCM terminal 31.
- The EBCM is faulty.

## ABS Indicator Lamp Illuminated Continuously, No DTCs Stored

| Step | Action | Value | Yes | No |
|---|---|---|---|---|
| 1 | Check the EBCM connector.<br>Is it connected properly? | - | Go to Step 3 | Go to Step 2 |
| 2 | Connect the EBCM connector.<br>Is the repair complete? | - | System OK | - |
| 3 | 1. Disconnect the EBCM connector.<br>2. Turn the ignition to ON.<br>3. Use an insulated tool to push the shorting bar in the connector away from terminal 20.<br>Does the ABS indicator lamp go out? | - | Go to Step 4 | Go to Step 5 |
| 4 | Replace the ABS unit<br>Is the repair complete? | - | System OK | - |
| 5 | Repair the short to ground in circuit Lg between I/P cluster connector B7 and terminal 20 EBCM.<br>Is the repair complete? | - | System OK | - |

# SELF-DIAGNOSTICS

**Important:** The electronic brake control module (EBCM) turns the valve relay off when a diagnostic trouble code (DTC) is set. The scan tool will indicate that the valve relay is off when it is used to monitor the data list. This is normal and should not be considered a malfunction.

The EBCM performs system self-diagnostics and can detect and often isolate system malfunctions, When it detects a malfunction, the EBCM sets a DTC that represents the malfunction, turns on the ABS and/or the TCS indicators in most instances, and may disable the ABS and/or the TCS function, as necessary, for the duration of the ignition cycle.

Once each ignition cycle, the EBCM performs an automatic test when the vehicle reaches 2.75 km/h (1.7 mph). In the course of this test, the system cycles each valve solenoid and the pump motor, along with the necessary relays, to check component operation. If the EBCM detects any malfunctions, it will set a DTC as described above.

## DISPLAYING DTCs

### Tools Required

Scan Tool

DTCs can be read through the use of the scan tool.

## CLEARING DTCs

### Tool Required

Scan Tool

The diagnostic trouble codes (DTCs) in the electronic brake control module (EBCM) memory are erased in one of two ways:

- Use the scan tool “Clear DTCs” selection.
- After 249 DTC-free ignition cycles.

These two methods are detailed below. Be sure to verify the proper system operation and, the absence of DTCs when the clearing procedure is completed.

The EBCM will not permit DTC clearing until all DTCs have been displayed. Also, ETC s cannot be cleared by disconnecting the EBCM, disconnecting the battery cables, or turning the ignition switch to LOCK.

### Scan Tool Method

The scan tool can clear ABS/TCS system DTCs using the mess storage cartridge.

1. Install the scan tool and the mass storage cartridge.
2. Select “Fault Memory”.
3. Select “Clear Fault Memory”.

Clearing the fault memory cannot reset a valve relay which was shut down when the fault was recognized. Changes are possible only after the fault has been eliminated and the next ignition cycle has begun.

### Ignition Cycle Default

A DTC is erased from memory after 249 ignition cycles without any reappearance of that malfunction.

# INTERMITTENT AND POOR CONNECTIONS

As with most electronic systems, intermittent malfunctions may be difficult to diagnose accurately, The following is a method to try to isolate an intermittent malfunction, especially in wheel speed circuitry.

If an ABS malfunction occurs, the ABS indicator will illuminate during the ignition cycle in which the malfunction was detected. If it is an intermittent problem which seems to have corrected itself (ABS indicator OFF), a history DTC will be stored. Also stored will be the history data of the DTC at the time the malfunction occurred. Use the scan tool modular diagnostic system to read ABS history data.

Most intermittents are caused by faulty electrical connections or wiring, although a sticking relay or solenoid can occasionally be at fault.

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