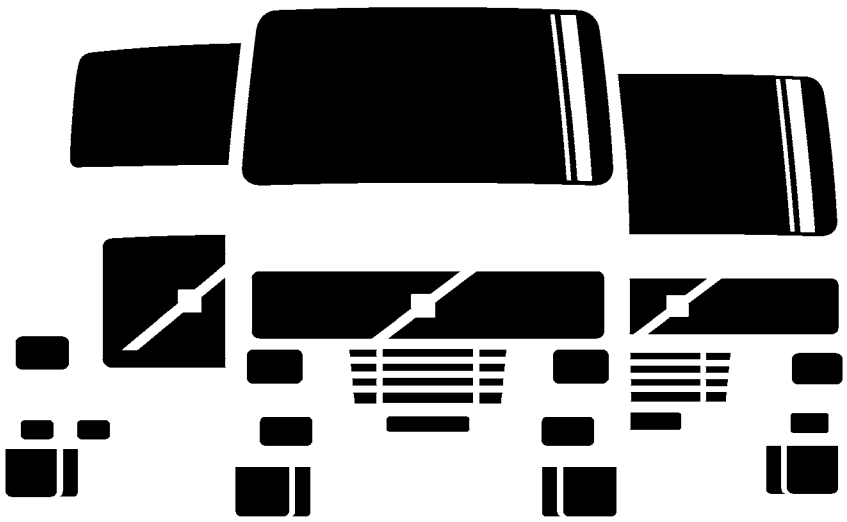
Service Manual
Trucks

Group **59**

Anti-Lock Brake System (ABS)
Bendix
VNL, VNM



PV776-TSP29984/1

VOLVO

Foreword

The descriptions and service procedures contained in this manual are based on designs and methods studies carried out up to April 98.

The products are under continuous development. Vehicles and components produced after the above date may therefore have different specifications and repair methods. When this is believed to have a significant bearing on this manual, supplementary service bulletins will be issued to cover the changes.

The new edition of this manual will update the changes.

In service procedures where the title incorporates an operation number, this is a reference to an S.R.T. (Standard Repair Time).

Service procedures which do not include an operation number in the title are for general information and no reference is made to an S.R.T.

The following levels of observations, cautions and warnings are used in this Service Documentation:

Note: Indicates a procedure, practice, or condition that must be followed in order to have the vehicle or component function in the manner intended.

Caution: Indicates an unsafe practice where damage to the product could occur.

Warning: Indicates an unsafe practice where personal injury or severe damage to the product could occur.

Danger: Indicates an unsafe practice where serious personal injury or death could occur.

Volvo Trucks North America, Inc.
Greensboro, NC USA

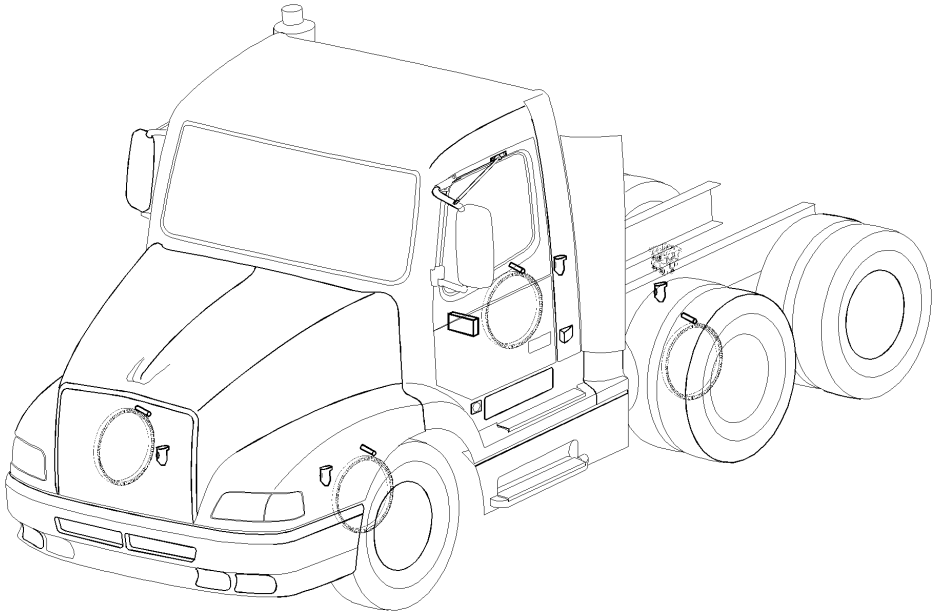
Order number: PV776-TSP29984/1

Contents

General

Anti-Lock Brake System

This service information describes the design, function, operation, and service procedures for the Bendix Anti-Lock Braking System used on Volvo VN series vehicles.



W5000526

General Safety Information

DANGER

Some brake linings contain non-asbestos fibers, the long term effects of which are unknown. Some older original equipment brake linings contain asbestos fibers, a cancer and lung disease hazard. Caution should be exercised in handling both asbestos and non-asbestos materials.

Most recently manufactured brake linings no longer contain asbestos fibers. In place of asbestos, these linings contain a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers, and carbon fibers. At present, OSHA does not specifically regulate these non-asbestos fibers, except as maintenance dust. Medical experts do not agree about potential long term risks from working with and inhaling non-asbestos fibers. Some experts think that long term exposure to certain non-asbestos fibers could cause diseases of the lung, including pneumoconiosis, fibrosis, and cancer. Therefore it is recommended that workers use caution to avoid spreading and breathing dust when working on brakes that contain non-asbestos fibers.

DANGER

Personal injury hazard. Never disconnect an air system component unless all system pressure has been depleted. Failure to deplete system pressure before disconnecting hoses or components may result in them separating violently and causing serious bodily injury or death.

Observe the following precautions when working with brakes and brake lining material:

1 Whenever possible, work on brakes in an area separate from other operations.

2 Always wear a respirator approved by NIOSH or MSHA during all brake service procedures. Wear the respirator during removal of wheels and throughout the assembly.

3 Never use compressed air or dry brushing to clean brake parts or assemblies. OSHA recommends that brake enclosures be used. These enclosures have vacuums with a **H**igh **E**fficiency **P**articulate **A**ir (HEPA) filter and worker arm sleeves. If such equipment is not available, carefully clean brake parts and assemblies in the open air.

4 Clean brake parts and assemblies in the open air. During disassembly, carefully place all parts on the floor to avoid getting dust into the air. Use an industrial vacuum cleaner with a HEPA filter system to clean dust from the brake drums, torque plate (spider), and other brake parts. After using the vacuum, remove any remaining dust with a rag soaked in water and wrung until nearly dry.

5 DO NOT grind or machine the brake linings.

6 Properly clean the work area. Never use compressed air or dry sweeping to clean the work area. Use an industrial vacuum with a HEPA filter and rags soaked in water and wrung until nearly dry. Dispose of rags with care to avoid getting dust into the air. Use an approved respirator when emptying vacuum cleaners and handling rags.

7 After working on brakes, workers should wash their hands before eating, drinking, or smoking. Clothes worn during brake maintenance should not be worn outside the maintenance area. Vacuum work clothes after use and launder them separately, without shaking, to prevent fiber dust from getting into the air.

8 Material Safety Data Sheets (MSDS) on brake linings, as required by OSHA, are available from the brake lining manufacturer.

DANGER

Do not work under or around a vehicle unless the wheels are securely chocked. Failure to chock the wheels can result in the vehicle rolling, which can cause serious bodily injury or death.

DANGER

Do not work under a vehicle supported only by jacks. Jacks can slip out from under the truck or fall over, causing personal injury or death. Always use jack stands under the truck.

DANGER

If placing a vehicle with Traction Control System (TCS) on jacks when servicing, the ABS must be disabled. If the ABS is not disabled and one of the wheels starts to spin, the TCS will compensate and the vehicle may come off the jack. The ABS should be disabled by disconnecting the ABS connector at the pass-through to the cab.

DANGER

Components in any air brake system may be under high pressure. Before disconnecting any air lines, be sure all air pressure is released. Failure to do so may result in the sudden, possibly explosive release of air pressure, causing parts to strike with considerable force, resulting in serious personal injury.

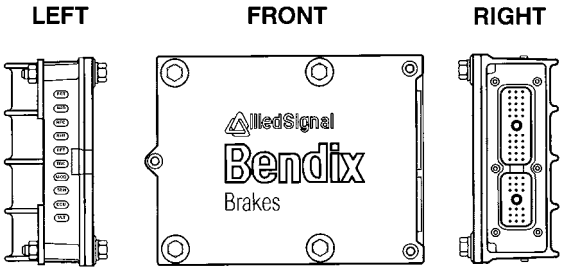
CAUTION

It is best to avoid welding on a truck or tractor or on components attached to it. Voltage and current spikes associated with welding can damage the vehicle's electrical system. If welding must be performed on any structure on or in contact with the vehicle, follow the recommendations below:

- Disconnect both negative (-) and positive (+) battery cables. Ensure the cables remain separated and are not in contact with the vehicle chassis.
- Disconnect the electrical harnesses for engine, ABS ECUs and all other ECUs on the vehicle.
- Disconnect the main vehicle harness at the pass through to the cab.

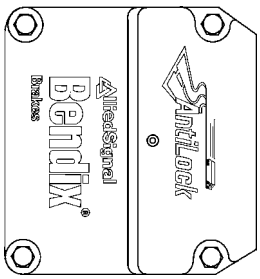
Specifications

Electronic Control Unit



W5000537

Bendix ABS ECU, early model



W5000952

Bendix ABS ECU, current model

Make, Model (early)	EC-16 (Bendix AL-6)
Make, Model (current)	EC-17 (Bendix AL-7)
Power requirement	12 VDC, 5-amp and 30-amp fuse

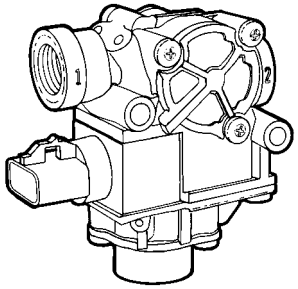
Inputs

Wheel speed information	100 pulses per wheel revolution, variable voltage
Traction control	enabled or disabled via dash switch

Outputs

Modulator valve signal	pulsating on/off
Traction control solenoid	on/off
Engine ECM	reduces engine torque
Data Link	diagnostic information to instrument cluster
Dash Lights	ABS warning light, Wheel Spin warning light

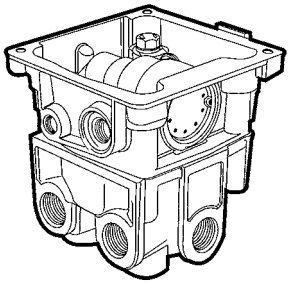
Modulator Valve



W5000518

Make, model ..... Bendix, M-22

Relay Valve

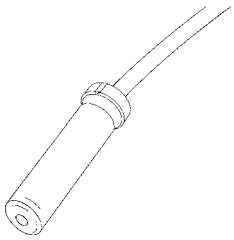


W5000371

Make, Model (for tractors without traction control) ..... Bendix, BP-R1

Make, Model (for tractors with traction control) ..... Bendix, ATR-2

Sensor



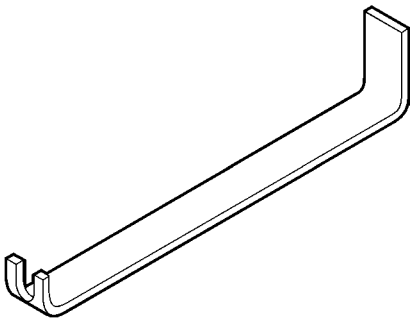
W5000579

Make, Model ..... Bendix, WS-20

Tools

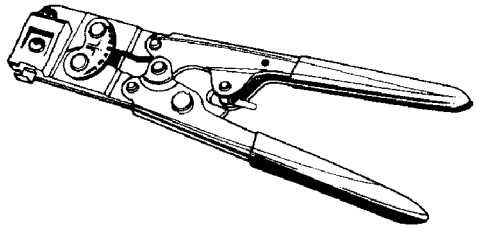
Special Tools

The following special tools may be required for work on the Anti-Lock Braking System. The tools can be ordered from the vendor specified in the tool description. Please use the corresponding tool number when ordering.



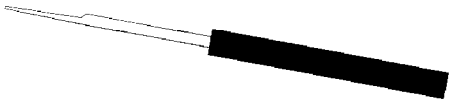
W0001489

J–42942 ABS sensor adjustment tool (Kent-Moore)



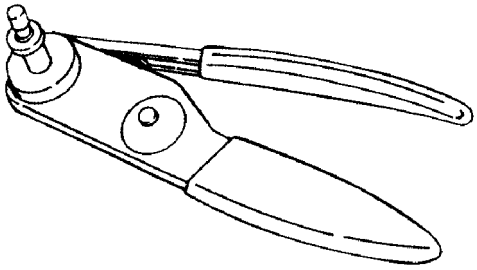
W0001490

J-35123 Metri-Pack hand crimp tool (Kent-Moore)



W0001491

J-38125 Metri-Pack contact removal tool (Kent-Moore)

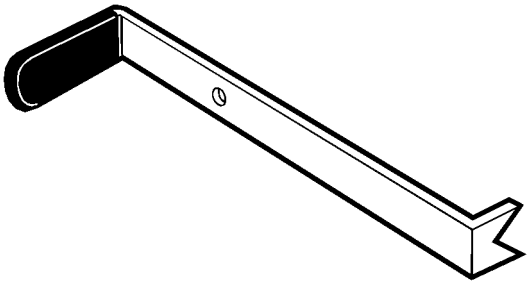


W0001492

J-34182 Deutsch universal hand crimp tool (Kent-Moore)

W0001493

J-37451 Deutsch heavy-duty contact removal tool (Kent-Moore)

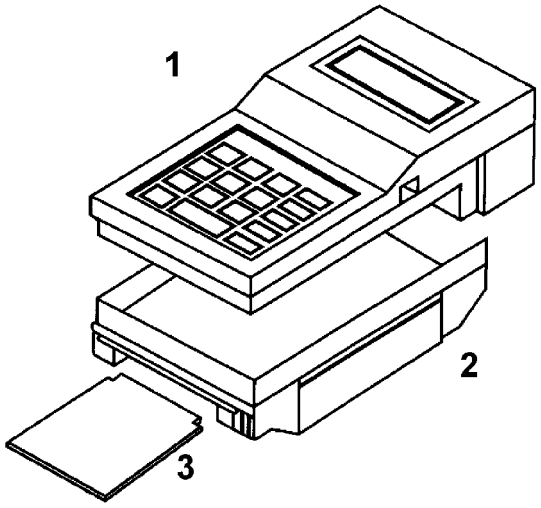


W0001198

J-42189 Air line release tool (Kent-Moore)

Other Special Equipment

The following special equipment may be required for troubleshooting the Anti-Lock Brake System and can be ordered from the vendor specified in the equipment description.

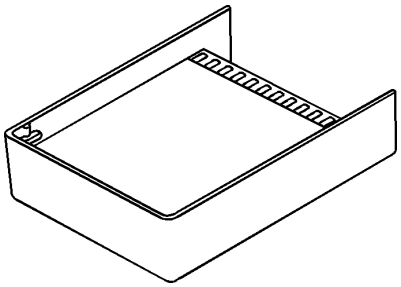


W3003010

108004 (1) Pro-Link 9000 (MPSI)

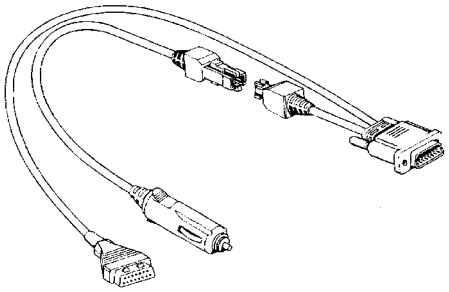
208040 (2) MPC cartridge (MPSI)

808013 (3) Bendix ABS (EC-17) application card (MPSI)



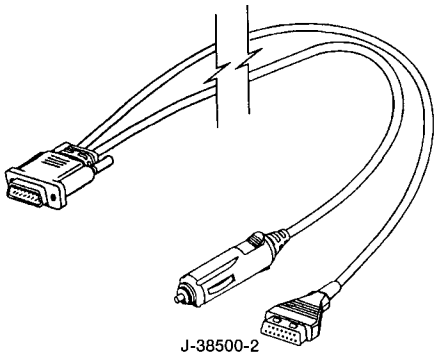
W3003017

J-38500–1100 MPSI Bendix ABS (EC-16) cartridge (Kent-Moore)



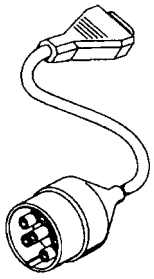
W3003009

501002 Power/Data Cable, current version (MPSI)



W5000944

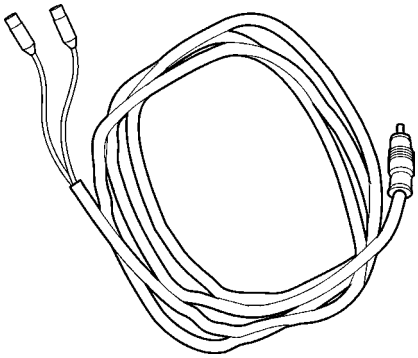
J-38500–2 Power/Data Cable, earlier version (Kent-Moore)



J-38500-60A

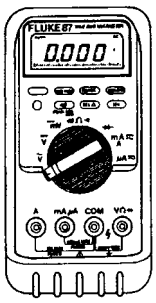
W5000946

J-38500–60A Diagnostic cable adapter (Kent-Moore)



W0001488

J-42883 Sensor pin-out cable (Kent-Moore)



W5000945

Fluke 87 Digital Multimeter (John Fluke Mfg. Corp.)

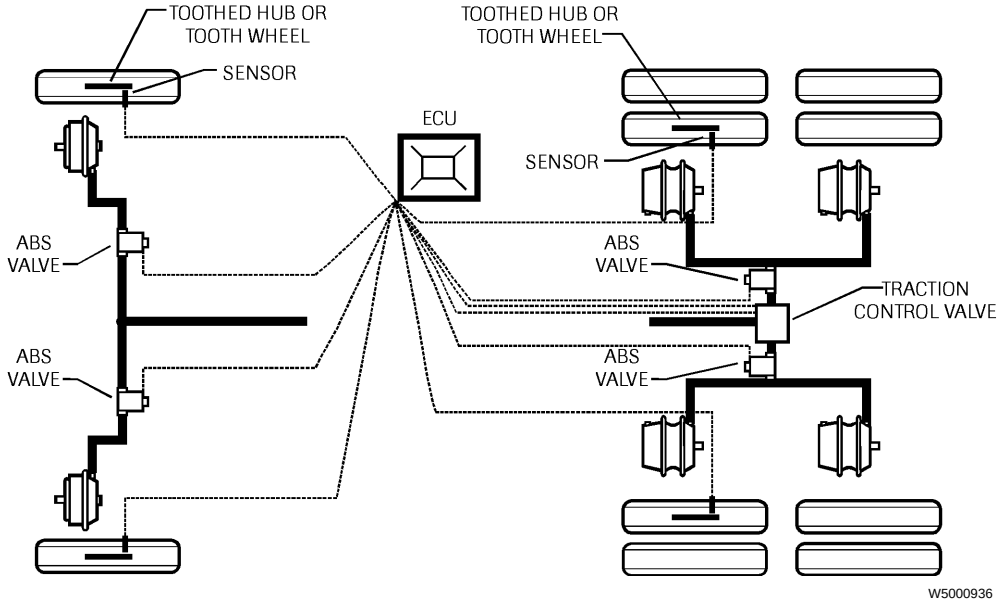
Design and Function

System Description

The Bendix Anti-Lock Braking System (ABS) is an electronically controlled system that continually monitors wheel speed and controls wheel braking during extreme braking situations, such as during hard braking or slippery road conditions. The ABS is an important component of the foundation brake system and works in conjunction with the standard vehicle braking system. It improves the vehicle's stability and control by reducing wheel lock during braking.

The ABS electronically monitors the rotational speed of both front wheels and the wheels on the rear axle (forward rear axle on tandem configurations). The wheel rotation signals are sent to an Electronic Control Unit (ECU) which sends signals to the ABS modulator valves if it detects that a wheel has locked up or is about to lock up. The modulator valves control the pressure in the brake assembly air chambers.

Wheel rotation is determined by an electronic sensor mounted in the brake spider. A signal is generated by the sensor as high spots on a tooth wheel pass by the sensor. The tooth wheel is either mounted on or is part of the wheel hub.



Note: Vehicle with spring suspension shown. Vehicle with air suspension has sensors on the rear axle.

When the ECU senses that a wheel or set of wheels is about to lock during braking, a signal is sent to the appropriate solenoid modulator valve to intermittently open and close it. This opening and closing occurs rapidly (as many as 15 times per second) to reduce brake pressure and ensure that the wheel returns to rotating while still maintaining most of the brake capacity.

If the brakes are applied and the wheel speed sensors detect an impending wheel lockup, the electronic control unit (ECU) controller will immediately begin to compensate using the ABS modulator(s) at the affected wheel(s). The rear axle brakes are controlled independently from the front axle brakes, so that brake application pressure at an individual wheel is adjusted solely on the basis of its behavior on the road surface on which it is traveling.

Although each steering axle brake is under the control of an individual modulator, the ECU controller does not treat these brakes independently. The ECU uses a modified individual control for the steering axle brakes. This is done in order to minimize “steering wheel pull” in the event each wheel is traveling on a different road surface, such as ice close to the curb and a dry crown. Essentially, the ECU controls the brake force difference between the two brakes. The wheel on dry pavement is initially given less braking force and is brought up to optimum during the stop, while the wheel on ice attempts to maintain optimum braking during the entire stop.

Traction Control System

Some vehicles are equipped with a Traction Control System (TCS or ATC) included with the ABS. The TCS prevents the drive wheels from spinning on a slippery surface (such as on ice or loose gravel), or when accelerating from a standstill. The TCS uses the ABS ECU for control, but requires additional control valves to automatically apply brake force to the spinning wheels to increase traction.

Components

The Bendix ABS consists of the following components:

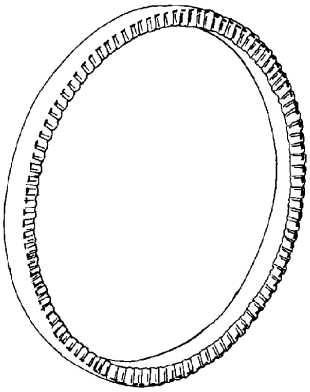
- Tooth Wheel (4 or 6)
- Magnetic Sensor (4 or 6)
- Modulator Valve (4)
- Electronic Control Unit (ECU)
- Fuses and Relays
- ABS Warning Lamp
- Wheel Spin Indicating Lamp
- Connectors
- TCS Switch (if TCS is installed)
- Traction Control Valve (if TCS is installed)

Tooth Wheel

The tooth wheel is an alloy ring that resembles a gear. It normally has 100 teeth cut into its surface. The purpose of the teeth are to cause a pulsating current flow in the sensor circuit. As each tooth passes near the sensor, it causes a small current to flow in the sensor. When the gap between two teeth is in front of the sensor, the current flow stops.

As the tooth wheel rotates, the starting and stopping of the current flow is registered by the ECU as pulses. The greater the speed of the tooth wheel past the sensor, the more pulses are registered per second, which is a direct indication of wheel speed.

The tooth wheel is manufactured either as a ring that is pressed onto the wheel hub, or is machined as an integral part of the hub itself.



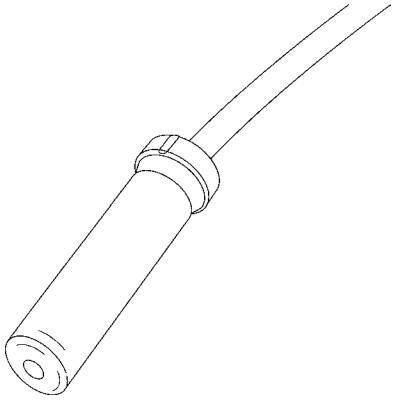
W5000530

Tooth wheel

Sensor

The sensor is a magnetic inductor that allows current to flow through it from the ECU when one of the wheel teeth is in front of it. It continuously provides wheel speed information to the ECU whenever the ignition is ON, regardless of whether or not the vehicle is in motion.

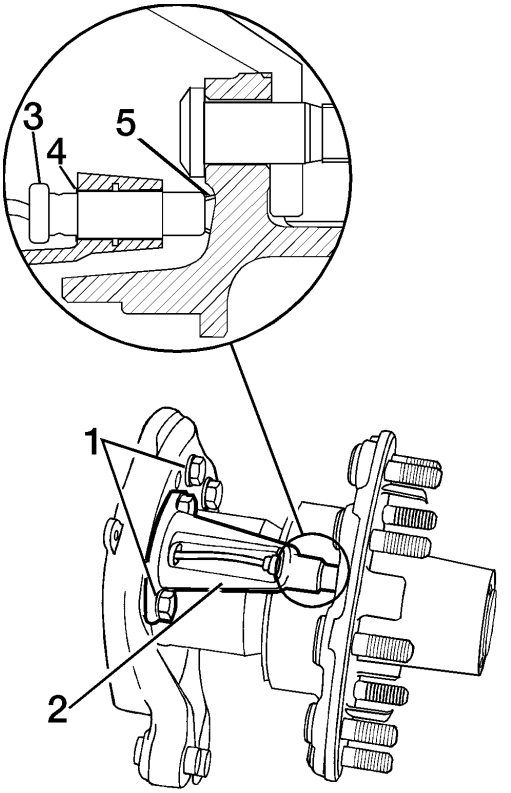
The sensors are installed in brackets that are bolted to the brake spider. Each sensor is held in the bracket by a spring clip. It is installed such that the sensor is as close to the tooth wheel as possible.



W5000579

Magnetic inductor sensor

The standard ABS has 4 sensors. On all vehicles equipped with ABS, each front wheel has a sensor, and there is one sensor for each complete set of rear wheels. For example, on a 4x2 vehicle, each rear wheel has a sensor. On a 6x4 vehicle with air suspension, the rear drive axle has the rear sensors. On a 6x4 with other suspension types, the forward drive axle has the rear sensors. A 6x4 vehicle with TCS has 6 sensors.



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Typical ABS sensor installation

1) Spider mounting bolts
2) Sensor bracket
3) Sensor
4) Spring clip
5) Tooth wheel

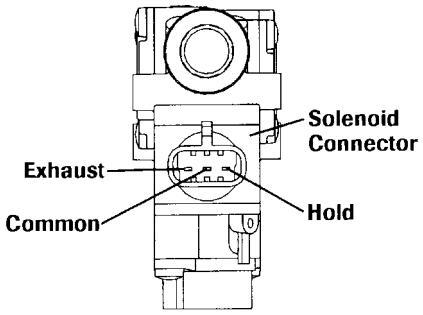
Modulator Valve

The Bendix M-22 modulator valve is a high capacity air solenoid valve. It has two solenoid coils. One of the coils is energized to isolate the brake chamber from the brake system air supply and vent the brake pressure from the brake chamber. The other coil is energized to isolate the brake chamber from the brake system supply and hold the pressure that is in the brake chamber.

During normal braking, compressed air flows freely through the modulator valves to the brake chambers. When ABS function is required, the modulator valve for the affected wheel is energized on and off in order to quickly, but incrementally, reduce the braking air pressure to the point where the wheel begins to spin freely.

The modulator valve can be used to control the brake chamber pressure on an individual chamber or on two service brake chambers. When used to control both service brake chambers on an axle or two chambers on the same side of a tandem axle, the modulator is usually mounted upstream of the quick release valve, which provides quick exhaust of brake pressure during normal applications. In the case of individual wheel control applications, the modulator is always the last control valve through which air passes on its way to the service brake chamber.

The valve consists of a die cast aluminum body and a solenoid assembly which contains one normally-open solenoid, one normally closed solenoid, and two inlet and exhaust diaphragm valves.



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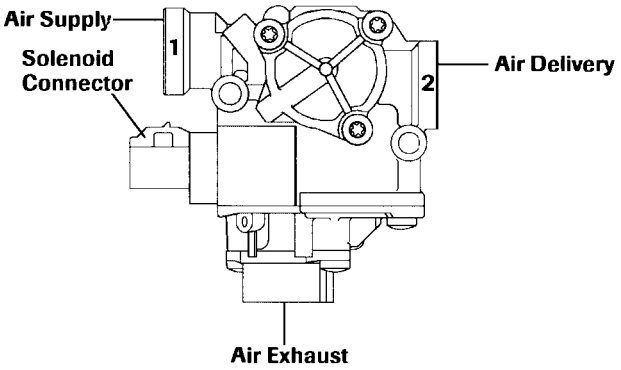


W5000534

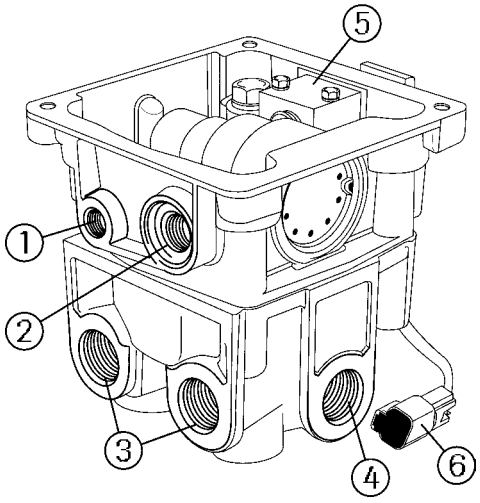
Relay Valve

There is a special type relay valve that is used with the Bendix ABS system with TCS. Normally, a standard R-14 Bendix relay valve performs the relay function with ABS. The inclusion of TCS requires that the relay valve have extra controls to provide braking air pressure during TCS operation.

In TCS equipped tractors, the Bendix ATR-2 replaces the standard BP-R1 bobtail proportioning valve. The ATR-2 is a specialized brake proportioning valve combined with a traction control solenoid. It contains pneumatic and electric components to provide both the service braking and traction control functions. During tractor bobtail operation, the ATR-2 reduces brake application pressure to the lighter rear axle brakes to improve vehicle control and minimize rear axle wheel skid before ABS is required.

All air connections on the ATR-2 are identified with cast, embossed letters. The designations and their meanings are as follows:

SUP ..... supply from reservoir
DEL ..... delivery to service actuators
SER ..... service signal from foot valve
CON ..... control signal from trailer supply valve



W5000536

1) Control
2) Service
3) Delivery
4) Supply
5) Traction solenoid
6) Solenoid connector

ABS Electronic Control Unit (ECU)

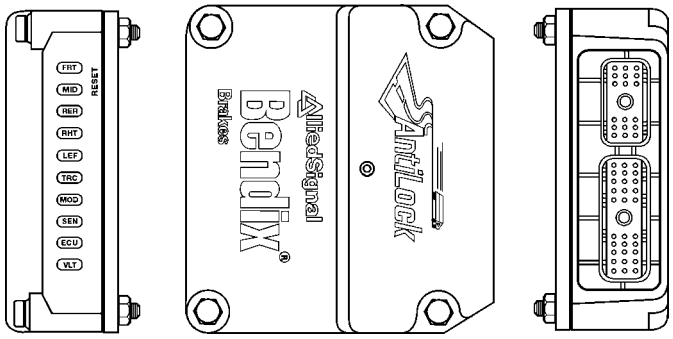
The ECU is the brain of the ABS system. It receives wheel speed information from the sensors and sends signals to the ABS modulator valves.

The ECU is powered through a 30–amp fuse on the ignition circuit. The ECU receives power only when the ignition is ON.

The ECU compares the wheel speed of each wheel to the speed of the other wheels to determine if any one wheel is locked up (i.e. not spinning or spinning very slowly in relation to the other wheels). This comparison is performed many times every second. If any wheel is determined to be locked up while the other wheels are spinning, the ABS sends signals to the modulator valve for the locked wheel to reduce its braking force until it starts to spin again. This series of events may occur as many as 15 times each second, giving the modulator valve the appearance of having a pulsating action.

If the Traction Control System (TCS) feature is installed, the ECU provides signals to the ATR valve to control driving wheel spin. The ATR valve is energized to apply air to the brake chambers on the set of drive wheels that are spinning. This action will slow the drive wheels to a speed consistent with vehicle speed to increase the traction of those wheels.

If the engine is equipped with electronic controls, the ABS ECU will also send a signal through a J1939 or J1922 data link to the engine ECU to reduce engine torque during wheel spin conditions. Above 25 mph, the ECU will only send the engine signal; no braking will occur.

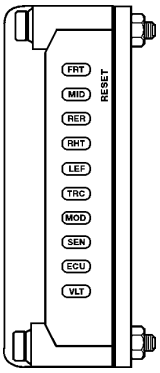


W5000951

Bendix ABS ECU, current model

The Bendix ABS ECU has built-in diagnostic capabilities and is equipped with a series of light emitting diodes (LEDs) that are visible from the outside. These LEDs are used in troubleshooting the faults in the anti-lock brake system. The LEDs are marked so that the technician can determine the location of a problem detected by the ECU. The designations are grouped to aid in determining the problem location and component.

The first three LEDs identify which axle has the faulty component and are labeled FRT for front, MID for middle, and RER for rear. The next two LEDs identify the side of the vehicle with the fault; RHT for right, LFT for left. The next four LEDs identify the faulty component; TRC for traction control components, MOD for modulator, SEN for sensor, and ECU. The final LED, which is the only green LED, is marked VLT. This LED indicates whether the ECU is receiving 12 volts. The VLT LED is ON during normal conditions.



W5000953

Left side of ECU showing LEDs

The ECU houses a magnetic switch that is used to erase faults from memory once they have been repaired. A fault is erased from memory (ECU reset) by holding a magnet next to the ECU where it is labeled RESET (just below the VLT LED). The magnet must be capable of lifting a 3 oz. weight in order to perform the reset function. While the magnet is held against the ECU all LEDs will illuminate. If the magnet is held against the ECU for more than 10 seconds, the ECU will enter a Self-Configuration mode.

When a fault is detected, an LED may not be lit from each group. An LED in the FRT, MID, and RER group will only light if the fault is with a sensor or an ABS modulator valve. The same is true for the RHT and LFT group LEDs. The TRC will be the only red LED lit if the problem is in the traction engine control circuit.

When power is applied to the ECU a start-up self-check sequence is activated. The status of the sequence is evident from the LEDs. The start-up LED sequence is as follows.

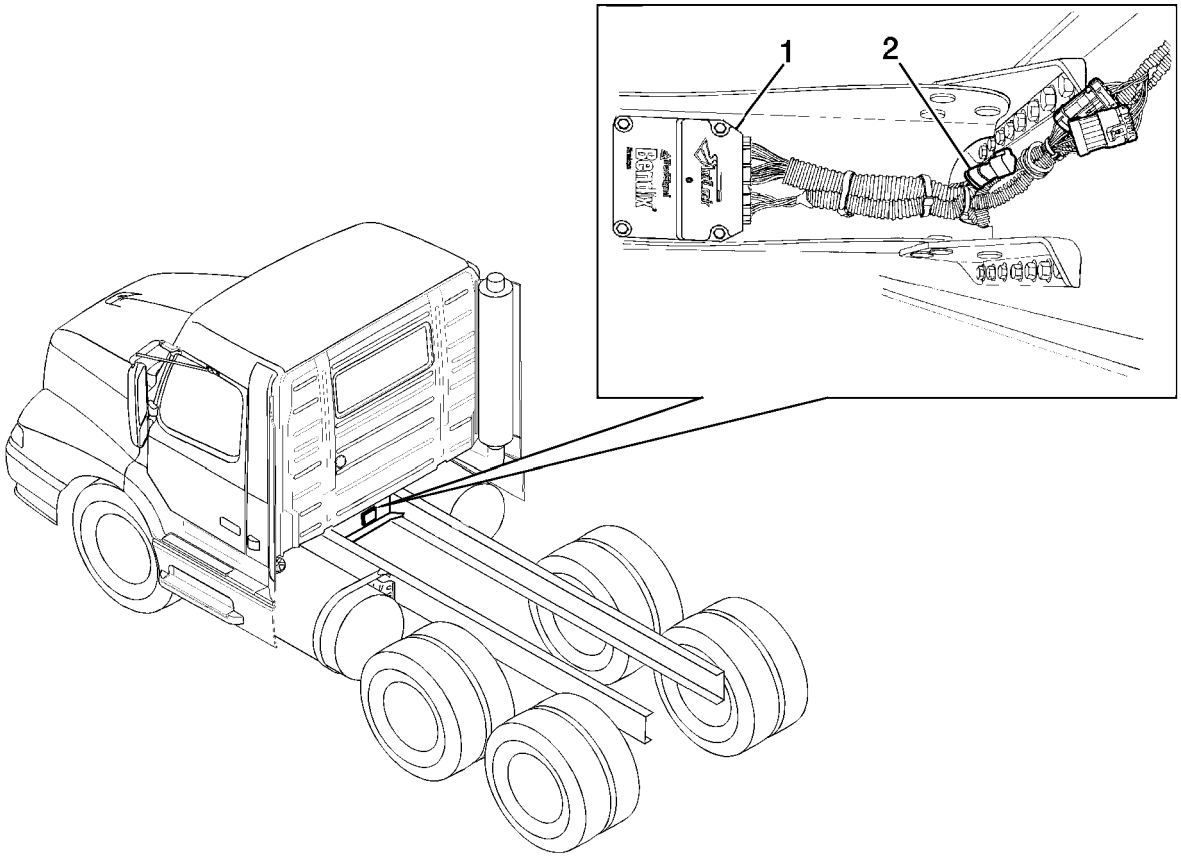
1 All LEDs flash ON.

2 All LEDs flash OFF.

3 SEN, FRT, and MID or RER LEDs come ON.

4 TRC LED comes ON (if J1922 engine control is disabled).

5 LEDs return to normal fault status (if no faults, green VLT will be only LED lit).



W5001014

ECU location: rear side of crossmember under or near the back of the cab.

1 Bendix ABS ECU

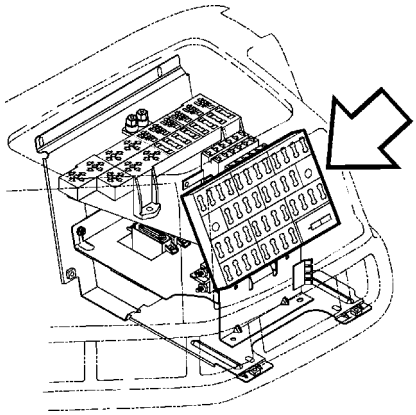
2 Terminating resistor

Electrical

Fuses

The ABS circuit is fused through a 30–amp fuse on the main fuse panel which is located behind the fuse panel cover. The power to operate the ABS comes from the ignition. The ABS Warning Lamp Relay (R3) is also powered through this same 30–amp fuse.

(For connection details, refer to “ABS System Diagram, VOLVO Engine” page 75 or “ABS System Diagram, Vendor Engine” page 76.)

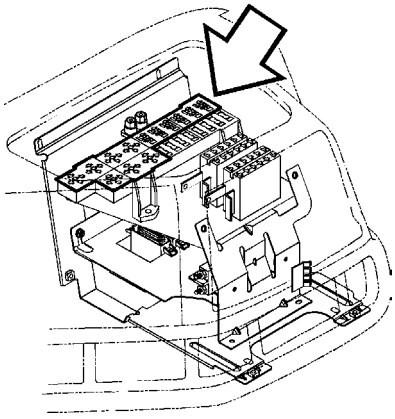


W3000773

Relays

When the ignition key is switched to ON, the ignition bus supplies power to the ABS ECU. Power is also supplied to the ABS Warning Lamp Relay (R3) from the ignition bus.

(For connection details, refer to “ABS System Diagram, VOLVO Engine” page 75 or “ABS System Diagram, Vendor Engine” page 76.)

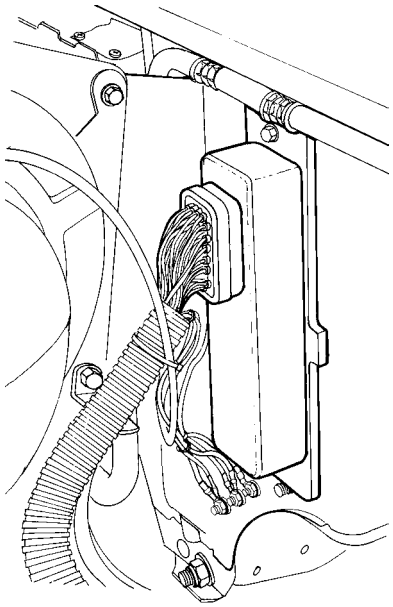


W3000774

Wiring

The wiring for the ABS is incorporated into the main cab and chassis wiring harnesses. Refer to the Electrical Schematics manual for further information on routing and location of ABS wiring.

(For connection details, refer to “ABS System Diagram, VOLVO Engine” page 75 or “ABS System Diagram, Vendor Engine” page 76.)

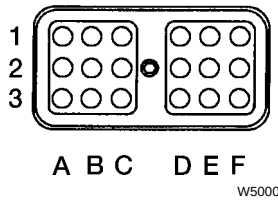


W3000801

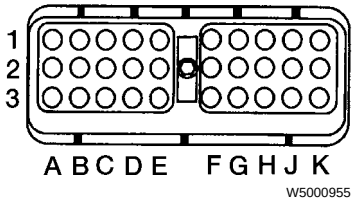
Connectors

The ABS ECU connectors include one 18–pin and one 30–pin Metri-pack 150 Series connector. The modulator valve connectors are 3 pin Packard 280 Series.

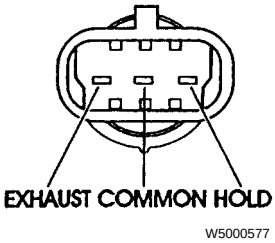
The pinout designations for each of the ECU connectors are located in “ABS System Diagram, Vendor Engine” page 76.



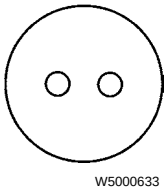
18–pin Metri-pack connector (on ECU)



30–pin Metri-pack connector (on ECU)



3–pin Packard modulator valve connector



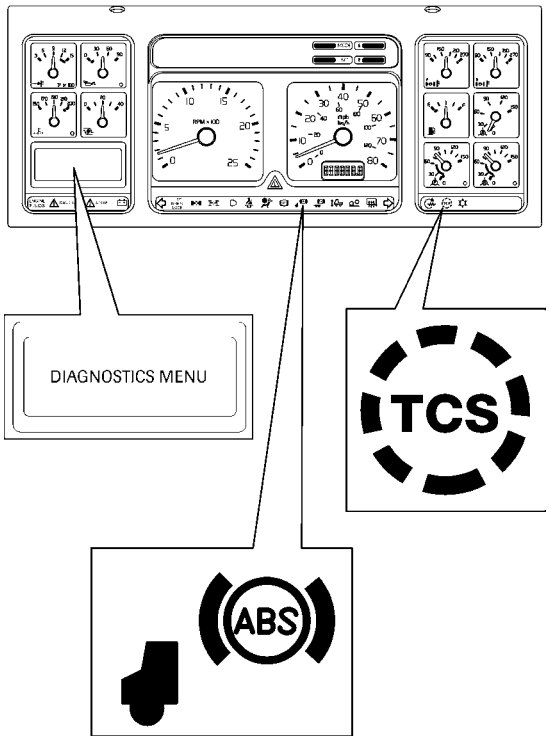
2–pin sensor connector (not polarity sensitive)

Instrumentation

ABS Warning Light

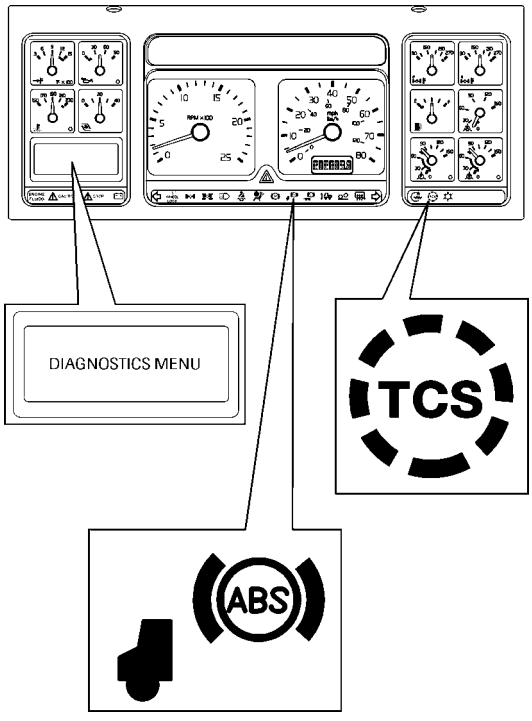
An amber ABS warning light is provided in the instrument cluster (center section). Its function is to notify the operator that the ABS system has detected an unusual condition or fault in the system. The lamp will illuminate under the following conditions.

- The ignition switch is turned to ON (The lamp will go off when the vehicle speed reaches approximately 11 km/h (7 mph).)
- The ABS self-monitoring circuits detect a fault in the system.



W5000585

Controls are located on the instrument cluster for earlier models.



W5000957

Controls are located on the wiper control arm for current models.

Wheel Spin Indicating Light

A yellow TCS warning light is provided on the instrument cluster (right section). This light is associated with both TCS and ABS. The light has several functions. If the TCS switch is in the OFF (up) position, the TCS light will come on to remind the driver that the TCS is selected to OFF. If TCS is not installed, the light will blink once per second anytime drive wheel spin is detected. If TCS is installed, the light will come on while the TCS system is controlling wheel spin. The TCS lamp will also come on and stay on if a fault is detected in the TCS circuits.

Data Link Diagnostic Display

The integrated multi-function display of the Dixson Data-Link is on the left side of the instrument cluster. It can be used to display diagnostic messages from the ABS. The system uses the SAE J1708/1587 data link and is installed in vehicles with electronically controlled engines. Refer to “Troubleshooting” page 25 for information on how to use the Data Link diagnostics to troubleshoot ABS problems.

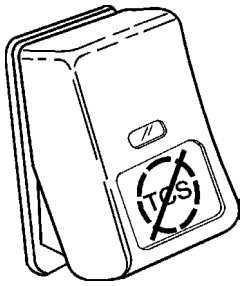
Traction Control System (TCS)

The ABS on a vehicle may also be configured for traction control. The Traction Control System (TCS) uses the same wheel sensors as the ABS to determine if one set of drive wheels is spinning much more rapidly than those on the other side. If the TCS determines that a wheel is spinning and the vehicle speed is below 40 km/h (25 mph), it opens the relay valve to apply some braking force to stop the wheels from spinning.

If the vehicle speed is above 40 km/h (25 mph), the system sends a signal to the Engine Electronic Control Unit (EECU) to reduce the engine rpm to be consistent with vehicle speed. This action helps reduce the amount of wheel spin and gives the driver greater vehicle control.

The TCS option includes an additional switch. In the normal (down) position, the TCS operates normally to increase traction to the spinning wheels. When placed in the off (up) position, the TCS does not apply braking force to the spinning wheels.

There is a yellow TCS warning light on the instrument cluster. The light has several functions. If the TCS switch is in the off position, the TCS light will come on to remind the driver that TCS is off. If TCS is not installed, the light will blink once per second while drive wheel spin is detected. If TCS is installed, the light will come on while the TCS system is controlling wheel spin. The lamp will also come on and stay on if a fault is detected in the TCS circuits.



W3001336

TCS switch

ABS Self Tests

The Bendix ABS has a variety of self monitoring features. When the ignition switch is ON, the ABS warning light in the instrument cluster energizes to tell the operator that the system is powered and that it is conducting self tests. There are two tests performed by the system at this point.

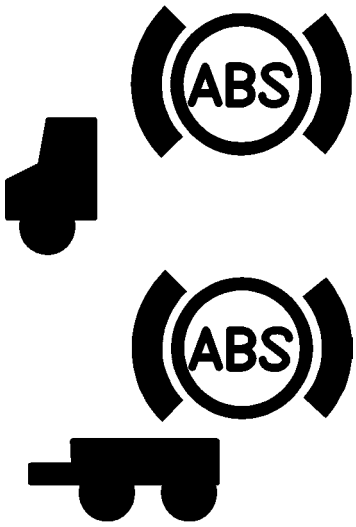
The first test energizes and de-energizes the modulator isolation solenoids to ensure the circuits and valves are functional. In the second test, the operation of the exhaust portion of the modulator valves is tested, also by energizing and de-energizing them.

One additional self-test is performed by the ABS. This test occurs once the vehicle begins moving. As the vehicle starts to speed up from a standstill, the ABS monitors the output from each of the wheel speed sensors and verifies that they are reading correctly, and within the correct range compared with the other wheels. If the test is satisfactory, the ABS warning light goes out when the vehicle speed reaches approximately 11 km/h (7 mph). If the test is not satisfactory, the warning light will remain lit.

ABS Fault Detection

During operation, the ABS continuously monitors the system for faulty conditions. The system components are checked to ensure they are in working order. If the ABS detects that a fault has occurred, as determined by the absence of correct signals from one of the ABS components, the system illuminates the ABS warning lamp. This lamp will stay on until the system has been repaired and the fault has been cleared from the system memory.

Note: When the system detects a fault, it deactivates the anti-lock braking function for the wheel that has the fault. For example, if a fault is detected in the right front modulator, the ABS function for that wheel will be disabled. However, normal braking ability is still available for this wheel. ABS function is still available for the remaining wheels.



W3000905

The Bendix ABS ECU has the ability to store the details of faults that it detects within its own memory so that the technician can easily locate the problem.

The details of the fault are stored in the system memory and will remain there until the fault has been repaired and the technician clears the fault memory. If the fault was intermittent, the details of the fault are stored only as long as the fault symptom is present. When the symptom disappears, the system returns to normal.

Following detection of any fault, the ABS warning light will go ON and stay on until the ignition is switched to OFF. If the fault is temporary, the warning light will go out normally when the vehicle reaches 11 km/h (7 mph). If the fault still exists, the warning light will remain on until the fault is repaired and is cleared from the memory.

The ABS can store the details of several faults within its memory. The ECU LEDs will indicate ONLY ONE fault at a time, even if there are mutiple faults. The faults must be repaired and removed from memory one at a time in the order they are displayed when using the ECU LEDs to troubleshoot. The instrument cluster may display multiple codes, but faults can be repaired in any order. The ABS warning light will not go out while the vehicle is being driven until all faults have been corrected and removed from memory.

Troubleshooting

General Troubleshooting

There are three methods for performing troubleshooting of the ABS:

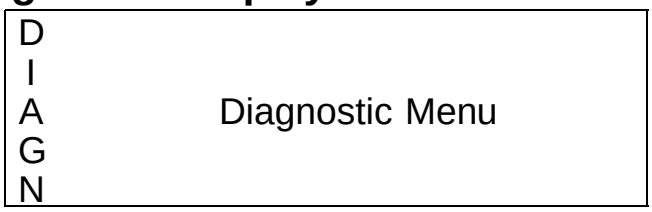
1 Use the diagnostic display on the Data Link instrument cluster. This is also the simplest method. (See “Data Link Instrument Cluster — Diagnostic Display” page 26.)

2 Use the MPSI Pro-Link 9000. (See “MPSI Pro-Link 9000” page 29.)

3 Use the ECU LEDs. (See “ECU LEDs” page 44.)

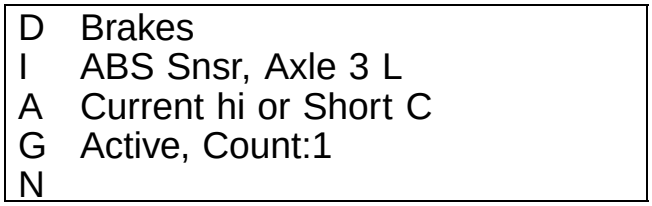
Data Link Instrument Cluster — Diagnostic Display

The integrated multi-function display of the Dixson Data link instrument cluster can be used to display diagnostic messages from the ABS. The system uses the SAE J1708/1587 data link and is installed in most vehicles with electronically controlled engines.



The Data Link diagnostic LCD display receives information from the ABS ECU. The messages are displayed on four lines, each line having a specific purpose. Line one displays the system, such as “ENGINE” or “TRANSMISSION.” For ABS troubleshooting purposes, line one will always be “BRAKES.” Line two displays the faulty component, such as “ABS Snsr Axle 1 L.” Line three displays the condition of the fault, such as “Voltage Shorted High.” Line four indicates whether the fault is currently ACTIVE or INACTIVE, and the count, which is how many occurrences of that fault have been detected since the system was last reset.

A typical diagnostic message for ABS is shown here.



Operation of the Data-Link diagnostics is covered later in this chapter.

Refer to Volvo Trucks North America Service Manual, PV776–381–620SM, Data Link Instrumentation, for more information.

Diagnosing Faults Using the Data Link Diagnostics

The following is a list of the possible faulty component messages for the Instrument Cluster Data Link diagnostic display (Line 2):

Message	Component Location
ABS Snsr Axle 1 L	Steering axle, left side
ABS Snsr Axle 1 R	Steering axle, right side
ABS Snsr Axle 2 L	Forward drive axle, left side
ABS Snsr Axle 2 R	Forward drive axle, right side
ABS Snsr Axle 3 L	Rear drive axle, left side
ABS Snsr Axle 3 R	Rear drive axle, right side
ABS Valve Axle 1 L	Steering axle, left side
ABS Valve Axle 1 R	Steering axle, right side
ABS Valve Axle 2 L	Forward drive axle, left side
ABS Valve Axle 2 R	Forward drive axle, right side
ABS Valve Axle 3 L	Rear drive axle, left side
ABS Valve Axle 3 R	Rear drive axle, right side
ABS Rtrdr Ctrl Relay	Electric brake
ABS DIF 1–ASR Valve	Traction control valve
ABS DIF 2–ASR Valve	Traction control valve

The following is a list of the possible fault condition messages for the Instrument Cluster Data Link diagnostic display (Line 3):

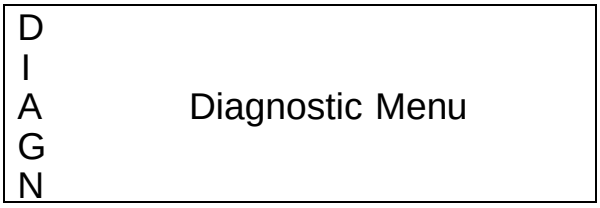
- Data Valid But High
- Data Valid But Low
- Data Erratic
- Voltage Shorted High
- Voltage Shorted Low
- Current Lo or Open C
- Current Hi or Short C
- Mech Syst No Response
- Abnormal Freq or PW
- Abnormal Update Rate
- Abnormal Change Rate
- Failure Unknown
- Bad Device
- Out Of Calibration
- Special Instructions

To view diagnostic messages for the ABS, perform the following:

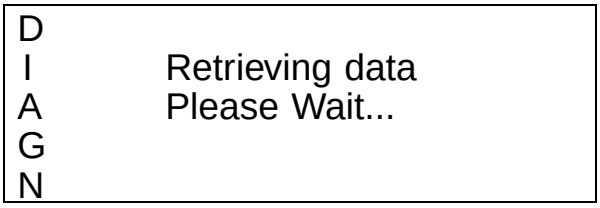
1 Stop the engine.

2 Turn the ignition key to ON.

3 Press the MODE button on the vehicle dash until the message “Diagnostics Menu” is displayed.

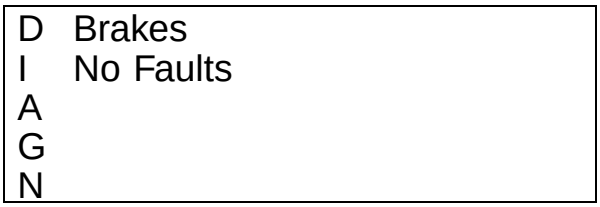


4 Press the SET button to have the datalink retrieve data.



5 Press the down arrow, then wait until a new message is displayed.

6 Repeat Step 5 until the ’Brakes’ display appears.



7 If a fault message appears, confirm the malfunction as suggested by the message and repair the fault using appropriate corrective action.

MPSI Pro-Link 9000

DANGER

PERSONAL INJURY HAZARD! Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

CAUTION

Possible damage to electronic components. Turn the vehicle ignition switch OFF before disconnecting or connecting any electrical components. Failure to de-energize circuits may result in electronic equipment damage.

The MPSI Pro-Link 9000 is a hand-held electronic diagnostic instrument. When used with the MPC cartridge and Bendix ABS application card (for the EC-17/AL-7) or with the Bendix ABS cartridge (for the EC-16/AL-6), the Pro-Link tool provides easy diagnosis of faults within the ABS, including:

- a faulty input;
- a faulty command; or
- a faulty reaction to a command.

In addition, the Pro-Link 9000 provides the ability to run a series of component tests on the ABS/ATC system.

DANGER

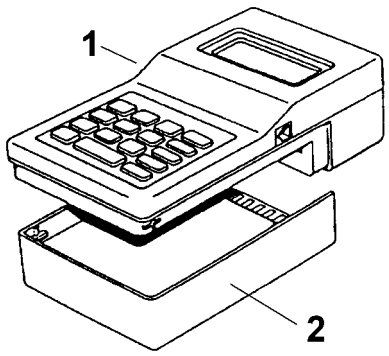
Exhaust gases contain deadly poison. When testing a vehicle with the engine running, conduct the test outdoors or use a properly vented exhaust hose.

WARNING

HOT ENGINE! Keep yourself and your test equipment clear of all moving or hot engine parts. A hot engine can cause serious burns or can permanently damage test equipment.

EC-16 (AL-6)

The MPSI Pro-Link 9000 is available from Kent-Moore. The Bendix ABS cartridge is required to use the Pro-Link 9000 on the Bendix ABS model EC-16 (AL-6). Refer to the Tools section for part numbers for the MPSI Pro-Link 9000 and the Bendix ABS cartridge.

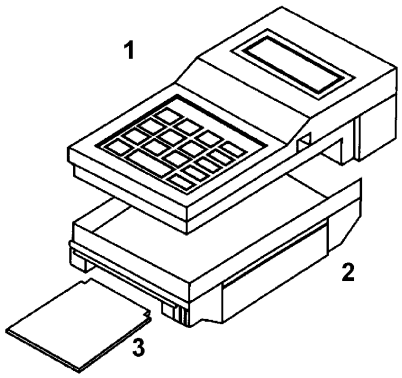


W5000943

1 MPSI Pro-Link 9000
2 Bendix ABS cartridge

EC-17 (AL-7)

The Pro-Link 9000/MPC tool is available from MPSI. The Bendix ABS application card is required to use the Pro-Link 9000 with MPC cartridge on the Bendix ABS model EC-17 (AL-7). Refer to the Tools section for part numbers for the MPSI Pro-Link 9000, the MPC data cartridge, and the Bendix ABS application card.



W3003010

1 MPSI Pro-Link 9000
2 MPC Data Cartridge
3 Application Card

Readout Window

The Pro-Link 9000 uses a liquid crystal display (LCD). The readout contains 4 display lines with 20 characters each and can include letters, numbers, and special symbols. The display includes a built-in backlight so that the display can be read in any light.

When the readout window shows a menu, the first three display lines shows the menu title and other helpful information. The last display line shows the first menu choice. Press the “up” or “down” arrow key to display the next menu item.

Press “ENTER” to select the menu item that is displayed on the bottom line of the screen. Or press “FUNC” to return to the previous menu (next higher level).

Keypad

The keypad features 16 keys, which are sealed to prevent contamination from grease and fluids.

Basic Key Functions

Numeric Keys The 10 numeric keys are arranged and used much as you would use a calculator.

Arrow Keys The “up” and “down” arrow keys are used to scroll through the lines of the display. Each touch of the key moves the display up or down one line. The “right” and “left” arrow keys are used to move between choices provided by the display.

ENTER Key This key is used to select a menu item, confirm an answer, or instruct the tool to go to the next step.

FUNC Key This key is used to “back out” of functions and menus.

Cleaning: The keypad can be cleaned with a damp cloth or mild cleaner. DO NOT immerse the Pro-Link/MPC tool in fluids, as as doing so will permanently damage the unit.

Push Button

Located on the left side of the Pro-Link/MPC tool is a red push button. The function of this push button is determined by the specific application card plugged into the MPC cartridge. The tool will instruct you when to press this button.

Installing and Removing the MPC Cartridge

With the MPC cartridge installed in the Pro-Link tool, you can use the Bendix ABS application card.

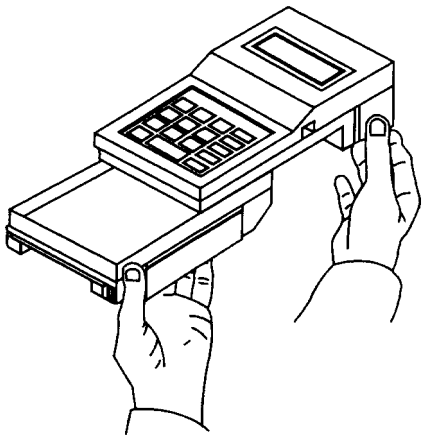
To Install the MPC Cartridge:

1 Disconnect the vehicle adapter (containing the 12–volt power feed) from the vehicle.

2 Seat the cartridge on the back of the Pro-Link tool. Do not hold the cartridge at an angle. It must sit flat. It will go only one way.

Note: The connector (edgeboard) of the cartridge automatically lines up with the connector and the Pro-Link unit.

3 Slide the cartridge forward until it clicks into place. The cartridge may be left in place indefinitely.



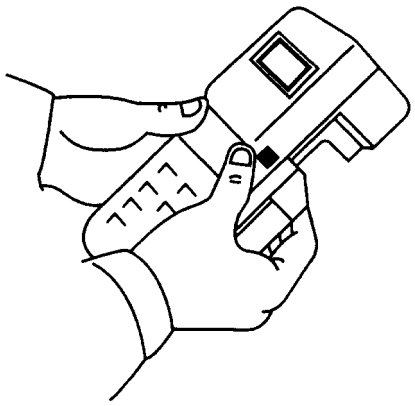
W3003011

To Remove the MPC Cartridge:

1 Place your thumbs on the slanted surface of the keyboard and your fingers on the cartridge.

2 Make a motion similar to snapping your fingers. The retention latches will release the outer end of the MPC cartridge.

3 Continue sliding the cartridge straight out until the edgeboard is clear of the connector in the Pro-Link tool.



W3003012

Non-Volatile Memory

The MPC cartridge has a non-volatile memory. This means that data is not lost when the Pro-Link/MPC tool is disconnected from the vehicle's power source.

When the Pro-Link/MPC tool is connected to an external power source (using the power cable in conjunction with the data cable), the Pro-Link/MPC tool recognizes that it is not communicating with an ECU. The "func" key is still active, and you can access stored data for review and printing. This includes "MPC Utilities" and "Recall Data."

Power/Data Cable

The data and power cable must be connected to the vehicle or an external 12–volt power source before the Pro-Link/MPC tool can function.

Connecting the Power/Data Cable

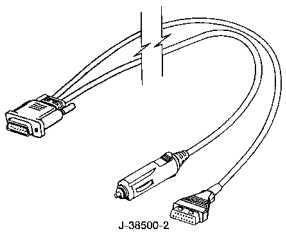
Earlier cables consisted of a single assembly; both the data cable and power cable are attached by a single molded connector. Later versions have two separate cables.

In both cases, the power cable includes a cigarette lighter adapter.

1 Locate the vehicle power/data cable (part number 501002 or J-38500–2). The cable has a large, 15–pin connector with two thumbscrews. Note that part 501002 is a two-piece cable and permits the removal of the power cable (containing the cigarette lighter adapter).

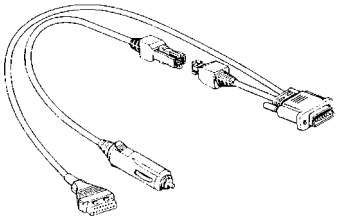
2 Plug the connector into the top of the Pro-Link/MPC tool.

3 Tighten the two thumbscrews to secure the cable.



W5000944

Power/data cable, earlier version



W3003009

Power/data cable, later version

Fuse

The standard power cable contains a replaceable fuse inside the cigarette lighter adapter. There is a fuse inside the MPC cartridge that can be reset.

Application Cards

Application cards are specific to the vehicle's computer system. Before beginning work on the vehicle, check the identification label on the application card to make sure you are using the correct vehicle application.

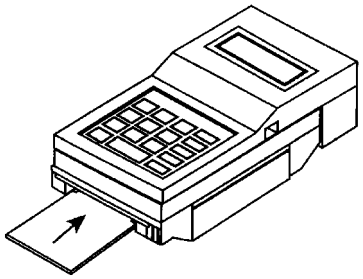
Installing the Application Card:

Slide the application card into the PCMCIA card slot on the MPC cartridge. The card will seat into the MPC cartridge only one way. Do not force the card into place.

Application cards can be inserted or removed while the Pro-Link is powered. Removal of the application card will halt the system. Reinserting the application card will reboot the ProLink tool.

When correctly seated, the eject button to the left of the PCMCIA card slot will pop out. **If the card seats but the eject button does not pop out, the card has been inserted upside down.** Pressing the eject button will remove only a properly inserted card.

Note: The "Write Protect" (W/P) switch must be in the OFF position for the application card to work properly.



W3003013

Diagnosing Faults Using the Pro-Link 9000

DANGER

PERSONAL INJURY HAZARD! Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

CAUTION

Possible damage to electronic components. Turn the vehicle ignition switch OFF before disconnecting or connecting any electrical components. Failure to de-energize circuits may result in electronic equipment damage.

DANGER

Exhaust gases contain deadly poison. When testing a vehicle with the engine running, conduct the test outdoors or use a properly vented exhaust hose.

WARNING

HOT ENGINE! Keep yourself and your test equipment clear of all moving or hot engine parts. A hot engine can cause serious burns or can permanently damage test equipment.

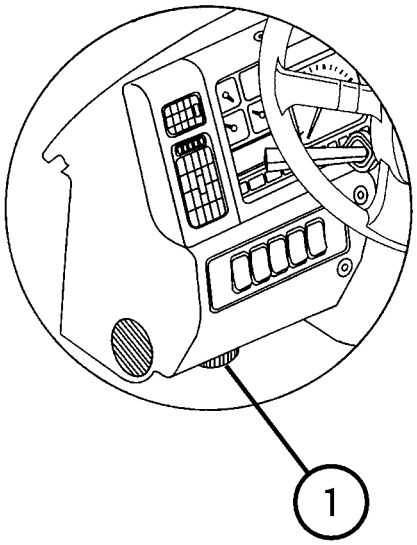
Using the Bendix ABS Application Card and MPC Cartridge (with EC-17/AL-7 ECU)

Perform the following steps to determine faults using the Pro-Link 9000.

1 Insert the MPC cartridge into the Pro-Link 9000 (see “Installing and Removing the MPC Cartridge” page 32).

2 Plug the male end of the data cable into the Pro-Link 9000. Tighten the thumbscrews to secure the cable.

3 Remove the dust cap from the vehicle diagnostics connector and connect the data cable to the diagnostics connector (1) on the vehicle.

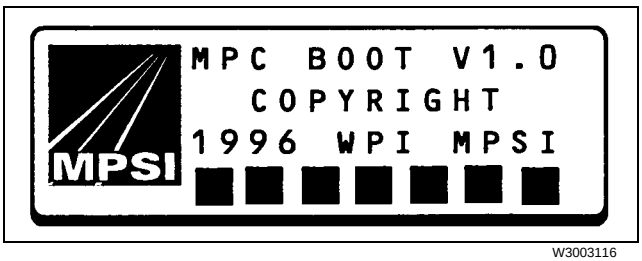


W5000547

1) Diagnostics connector location

4 Place the vehicle ignition switch ON.

5 Verify the Pro-Link 9000 powers up properly by observing the following display.



W3003116

6 Insert the Bendix ABS application card into the MPC cartridge (see “Application Cards” page 34). The display should indicate that the ABS/ATC application is ready to be selected.

Note: From this display, you can also use the up or down arrows to choose either “MPC Utilities” or “Load All Applications” for the MPC Utilities Menu Structure (for more information, refer to the Pro-Link/MPC operator’s manual).

BENDIX MPC
↑ - - - - Selections - - - - ↓
BENDIX ABS/ATC v1.0

With BENDIX ABS/ATC v1.0 on the bottom line of the display, press ENTER to continue to the “Bendix ABS/ATC Application Menu Structure.”

Note: To exit to the previous menu, press FUNCTION.

7 With the Bendix ABS/ATC application running, you can choose from the following main options (for a flowchart showing application options, see “MPC Application Menu Structure” page 39):

- Diagnostic Codes
- Data List
- Reset ECU
- Test System
- System Configuration
- ECU Information

BENDIX ABS/ATC
VERSION 1.00
↑ - - - - Selections - - - - ↓
DIAGNOSTIC CODES

Use the up or down arrows to scroll to the desired option. With the “Diagnostic Codes” option on the bottom line of the display, press ENTER to continue.

Note: To exit to the main menu options, press the FUNCTION key.

8 The Diagnostic Codes menu lets you choose from the following diagnostic functions:

- Active Faults
- Fault History
- Clear Fault History
- Clear Active Faults

DIAGNOSTIC CODES
↑ - - - - Selections - - - - ↓
ACTIVE FAULTS

Note: As with all menu options, use the up or down arrow to scroll to the desired function, and press ENTER to begin the function. To end use of a function, press the FUNCTION key. This will return you to the previous screen (refer to the Pro-Link/MPC operator's manual for more detailed information about these functions).

9 Return to the Bendix ABS/ATC main option menu (you may need to press the FUNCTION key). The "Diagnostic Codes" menu option should be on the bottom line of the display.

10 Using the up or down arrow keys, scroll to the "Data List" option.

BENDIX ABS/ATC
VERSION 1.00
↑ - - - - Selections - - - - ↓
DATA LIST

To select the "Data List" option, press ENTER. This lets you view data list parameters in sequence of operation. Press FUNCTION to exit back to the main option menu.

11 Using the up or down arrow keys, scroll to the "Reset ECU" option.

BENDIX ABS/ATC
VERSION 1.00
↑ - - - - Selections - - - - ↓
RESET ECU

To select the "Reset ECU" option, press ENTER. This function lets you reset the ABS ECU. Press FUNCTION to exit back to the main option menu.

12 Using the up or down arrow keys, scroll to the "Test System" option.

BENDIX ABS/ATC
VERSION 1.00
↑ - - - - Selections - - - - ↓
TEST SYSTEM

To select the "Test System" option, press ENTER. This function lets you test the operation of components of the ABS/ATC system. These include:

- Pulse Modulator
- Test Modulator
- Retarder Relay
- Traction Lamp
- Warning Lamp
- Disable Traction

Press FUNCTION to exit back to the main option menu.

13 Using the up or down arrow keys, scroll to the "System Configuration" option.

BENDIX ABS/ATC
VERSION 1.00
↑ - - - - Selections - - - - ↓
SYSTEM CONFIG

To select the "System Configuration" option, press ENTER. This function lets you view and edit the configuration of the ABS ECU system. This includes:

- View Configuration
  - View Tire Size
  - View System Setup
- Edit Configuration
  - Self Configuration

Press FUNCTION to exit back to the main option menu.

14 Using the up or down arrow keys, scroll to the “ECU Information” option.

BENDIX ABS/ATC
VERSION 1.00
↑ - - - - Selections - - - - ↓
ECU INFORMATION

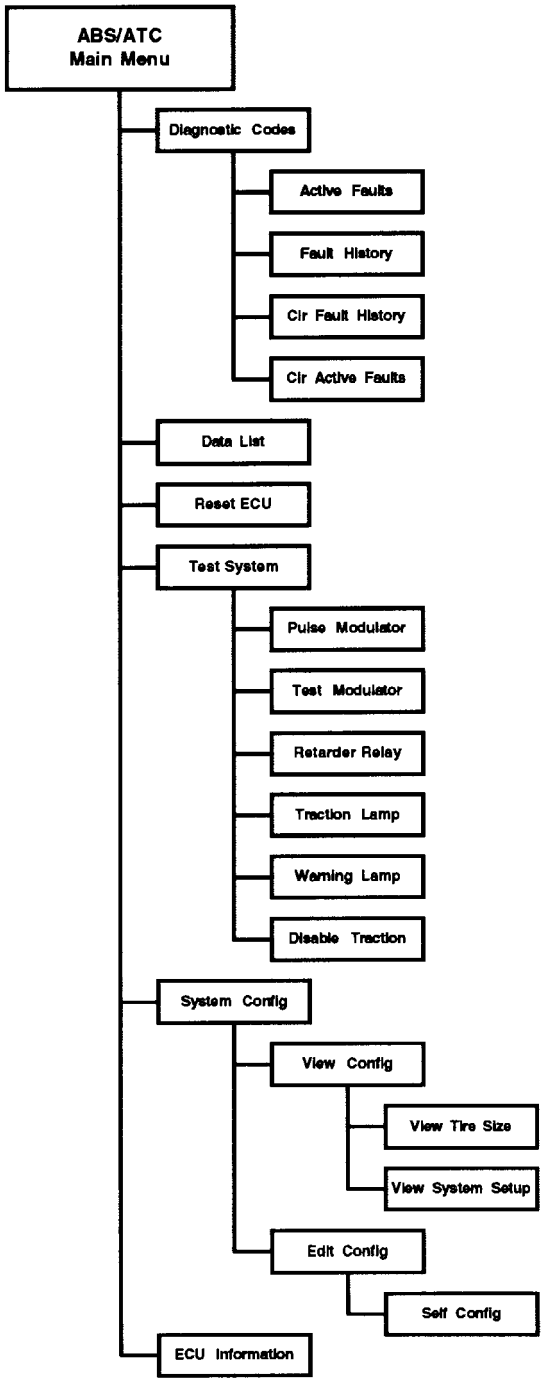
To select the “Reset ECU” option, press ENTER. This function displays information about the ECU being tested. Press FUNCTION to exit back to the main option menu.

15 Press the FUNCTION key when finished to end the session.

16 When troubleshooting is complete, turn the vehicle ignition to OFF, remove the application card from the MPC cartridge, and disconnect the power/data cable from the diagnostics connector in the vehicle. Replace the diagnostics connector dust cap.

MPC Application Menu Structure

The application menu structure will assist you in locating specific functions of the Bendix ABS/ATC application card.



W3003132

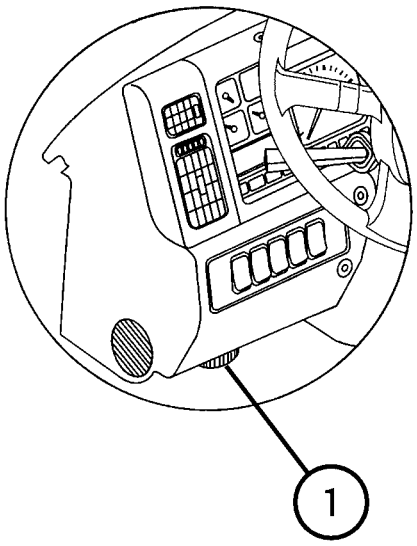
Using the Bendix ABS Cartridge (with EC-16/AL-6 ECU)

Perform the following steps to determine faults using the Pro-Link 9000.

1 Insert the Bendix ABS cartridge into the Pro-Link 9000/MPC tool.

2 Plug the male end of the data cable into the Pro-Link 9000. Tighten the thumbscrews to secure the cable.

3 Remove the dust cap from the vehicle diagnostics connector and connect the data cable to the diagnostics connector (1) on the vehicle.



1) Diagnostics connector location

4 Place the vehicle ignition switch ON.

5 Verify the Pro-Link 9000 powers up properly by observing the following display.

MPSI Pro-Link 9000
SOFTWARE COPYRIGHT
1995 VERSION 1.0
BENDIX ABS/ATC

6 Verify the Pro-Link establishes communication with the ABS by observing a display similar to the following.

4 SENSOR ABS
ACTIVE FAULTS YES
FAULT HISTORY YES
[ENTER] TO CONTINUE

7 Verify the information displayed matches the vehicle configuration (4 sensor or 6 sensors). If it does not, refer to the MPSI Pro-Link 9000 manual for the Bendix ABS/ATC System to change the Pro-Link 9000 test configuration.

8 Press ENTER to access the function selections menu.

9 If ABS/ATC does not have brackets around it, press the left arrow to place brackets around ABS/ATC, then press ENTER.

FUNCTION SELECTIONS
SELECT DESIRED
MENU
[ABS/ATC]← →Pro-Link

10 With the DIAGNOSTIC CODES menu displayed, press ENTER to go to the faults menu.

BENDIX ABS/ATC
- - - - - SELECTIONS - - - - -
↑ DIAGNOSTIC CODES ↓

11 When the ABS MENU appears, use the up and down arrow keys to scroll to ACTIVE FAULTS or FAULT HISTORY, then press ENTER.

BENDIX ABS/ATC
- - - - - SELECTIONS - - - - -
↑ ACTIVE FAULTS ↓

12 If there are any faults of the type selected, the Pro-Link 9000 will display them one at a time, such as in the example below.

LEFT FRONT SENSOR
SENSOR OPEN
↑ A1 DEV: 11 FLT: 01 ↓

The last line of the display provides information regarding the fault. In the example, “A1” refers to the number of the **A**ctive fault assigned by the ECU. “H1” would refer to the first fault stored in the fault **H**istory. “DEV:” refers to the device number of the faulty component, such as 11 for Left Front Sensor or 22 for Right Rear Modulator. “FLT:” identifies the specific type fault such as 01 for sensor open or 80 for shorted modulator.

13 Correct the active faults using appropriate Service Procedures or other repair method.

14 Press the FUNC key to return to the fault selection menu.

15 Use the up or down arrow keys to select CLR ACTIVE FAULTS or CLR FAULT HISTORY, then press ENTER. The following screen will appear.

CLR ACTIVE FAULTS
ARE YOU SURE ?
YES ← → [NO]

If sure, press the left arrow to place brackets around YES, then press ENTER.

16 If clearing ACTIVE FAULTS was successful, repeat the clearing process for FAULT HISTORY, otherwise repeat the entire process to repair and clear ACTIVE FAULTS.

17 Press FUNC several times to return to the function selections menu.

FUNCTION SELECTIONS
SELECT DESIRED
MENU
[ABS/ATC]← →Pro-Link

18 When troubleshooting with the Pro-Link 9000 is complete, turn the vehicle ignition to OFF, then disconnect the Pro-Link 9000. Replace the diagnostics connector dust cap.

System Testing Using the Pro-Link 9000 (EC-16/AL-6)

There are several tests that can be run on the Bendix system using the MPSI Pro-Link 9000. The available tests are:

- Vehicle voltages
- ABS modulator valves
- Traction control valve
- ABS/Wheel spin dash warning lamps
- Sensors
- Engine datalink
- Retarder relay
- Retarder datalink

Preparing for Testing

Perform the following steps to set up the Pro-Link 9000 to run system tests:

1 Insert the Bendix ABS cartridge into the Pro-Link 9000.

2 Plug the male end of the data cable into the Pro-Link 9000. Tighten the thumbscrews to secure the cable.

3 Connect the female end of the data cable to the data link connector on the vehicle.

4 Place the vehicle ignition switch ON.

5 Verify the Pro-Link 9000 powers up properly by observing the following display.

MPSI Pro-Link 9000
SOFTWARE COPYRIGHT
1995 VERSION 1.0
BENDIX ABS/ATC

Note: ATC on the MPSI Pro-Link 9000 displays refers to the Traction Control System

6 Verify the Pro-Link establishes communication with the ABS by observing a display similar to the following.

4 SENSOR ABS
ACTIVE FAULTS YES
FAULT HISTORY NO
[ENTER] TO CONTINUE

7 Verify that the information displayed matches the vehicle configuration (4 sensors, 4 valves). If it does not, change the Pro-Link 9000 test configuration (refer to the MPSI Pro-Link 9000 manual for the Bendix ABS/ATC System).

8 Press ENTER to access the function selections menu.

9 If ABS/ATC does not have brackets around it, press the left arrow to place brackets around ABS/ATC, then press ENTER.

FUNCTION SELECTIONS
SELECT DESIRED
MENU
[ABS/ATC]← →Pro-Link

10 With the DIAGNOSTIC CODES menu displayed, press ENTER to go to the faults menu.

BENDIX ABS/ATC
- - - - - SELECTIONS - - - - -
↑ DIAGNOSTIC CODES ↓

11 When the ABS selections menu appears, use the down arrow key to scroll to TEST SYSTEM. Then press ENTER.

ABS MENU
- - - - - SELECTIONS - - - - -
↑ TEST SYSTEM ↓

12 Use the up and down arrow keys to scroll to the test of your choice, then press ENTER to run the test.

13 When system testing is complete, press FUNC to return to the selections menu. Use the up or down arrow keys to scroll to DATA LIST, then press ENTER.

14 The Pro-Link 9000 will display the current value of four parameters. Press the down arrow to view additional parameters. The status of the following parameters can be displayed by the Pro-Link 9000.

- L FRONT MPH
- R FRONT MPH
- L REAR MPH
- R REAR MPH
- L MIDDLE MPH
- R MIDDLE MPH
- BATT VOLTAGE
- TRACTOR LAMP
- WARNING LAMP
- RETARDER RELAY
- ENGINE IDLE
- SBEND RELAY
- ENGINE DATA LINK
- RETARDER DATA LINK

15 At any time, press FUNC to move back to the previous menu (one level higher).

16 When all testing is complete, turn the vehicle ignition switch to OFF before disconnecting the Pro-Link 9000.

ECU LEDs

The condition of specific ABS/TCS components is provided by a series of LED's on the side of the ECU housing. If an error condition is detected within the system by the ECU, one or more of the LEDs will light to show the location and component associated with the fault.

There are ten LEDs plus a magnetically activated reset switch in the ECU diagnostics. The LEDs are software driven and are either ON, OFF, or flashing, depending upon their monitoring function (see ECU Diagnostic LEDs table page 44).

ECU Diagnostic LEDs

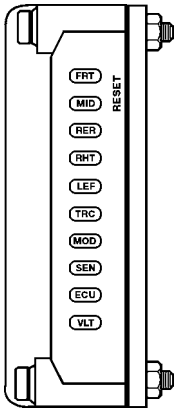
Label	Identifies	Color	Signifies
FRT	Steer axle	Red	Fault detected on a steering axle ABS component or its wiring.
MID	Forward drive axle	Red	Fault detected on a forward drive axle ABS component or its wiring.
RER	Rear drive axle	Red	Fault detected on a rear drive axle ABS component or its wiring.
RHT	Right side of vehicle	Red	Fault detected in a component that is on the right side of the vehicle.
LFT	Left side of vehicle	Red	Fault detected in a component that is on the left side of the vehicle.
TRC	Traction control	Red	Fault detected in an TCS component or circuit.
MOD	ABS modulator valve	Red	Fault detected in an ABS modulator valve or its wiring or with an ATR-2 traction control valve.
SEN	ABS wheel speed sensor	Red	Fault detected in an ABS wheel speed sensor or its wiring.
ECU	ECU electronic controller	Red	The ECU has detected a failure in its own circuitry.
VLT	Voltage supply to ABS	Green	Indicates that voltage is supplied to the ECU and that the voltage is in the correct range (11 to 17 VDC). This LED flashes if voltage is present but out of range.

Diagnosing Faults Using the ECU LEDs

The troubleshooting diagrams and flowcharts in this section provide a method to help locate a fault that is indicated by the ECU LEDs.

Technicians experienced in troubleshooting Bendix ABS problems may begin troubleshooting using the quick reference flow charts on the next two pages. Less experienced technicians should begin troubleshooting using the Initial Start-Up Procedure flow chart.

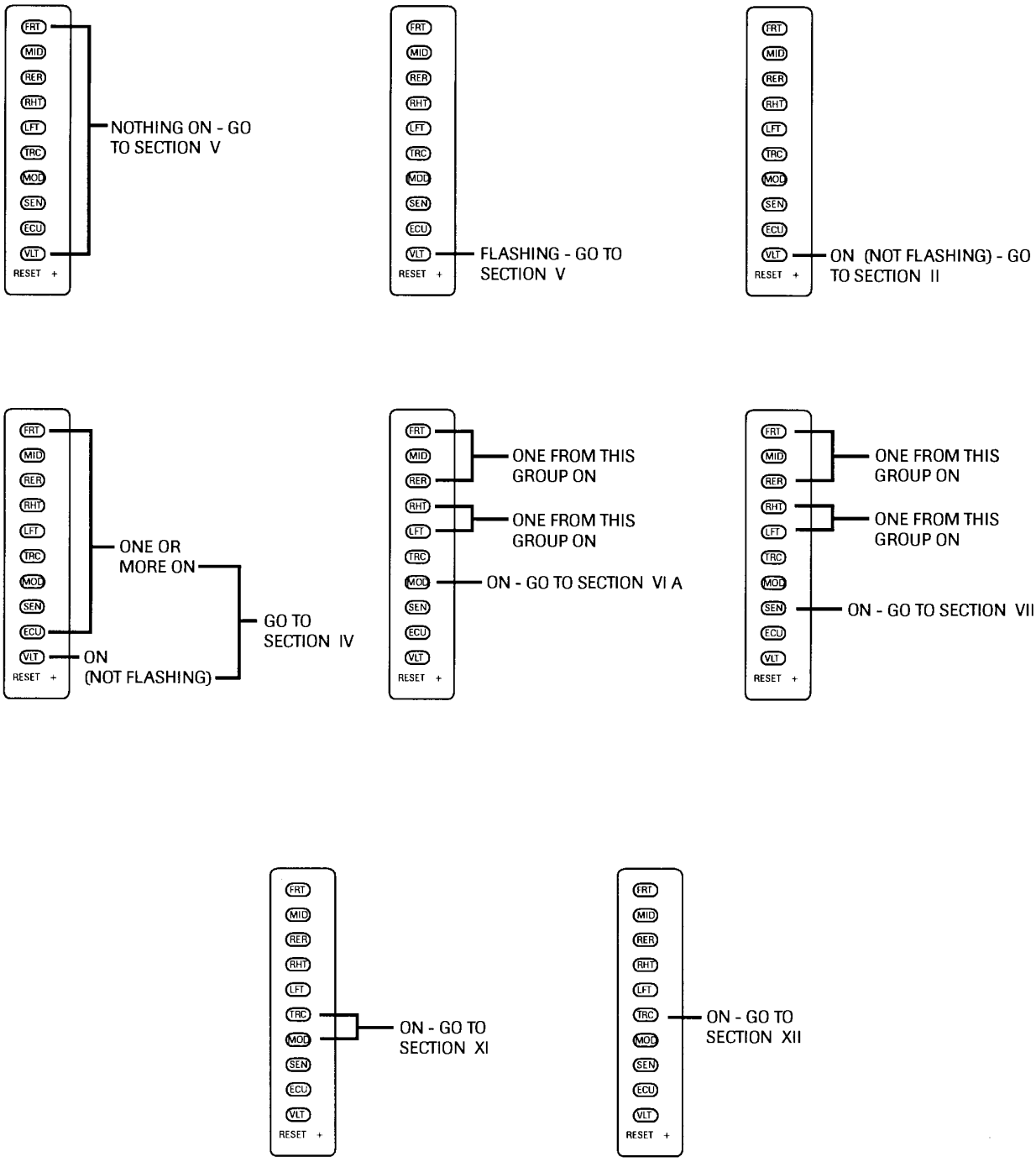
When a fault has been identified and corrected, reset the ECU diagnostics by passing a small magnet over the point labeled RESET on the ECU (the magnet must be strong enough to pick up a 3 oz. weight). If additional faults exist, repeat the troubleshooting process.



W5000953

TROUBLESHOOTING QUICK REFERENCE

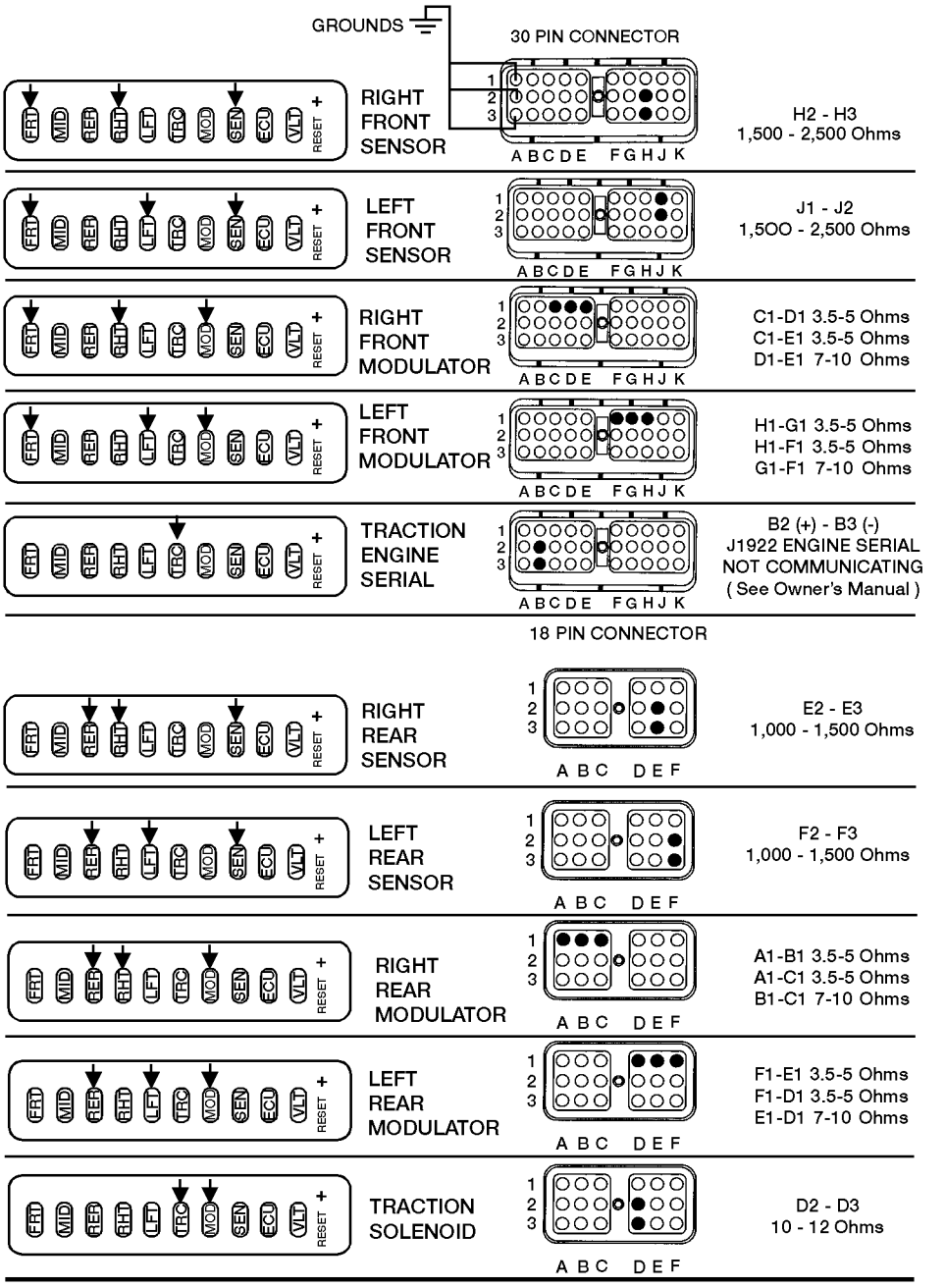
This index is presented for the benefit of personnel experienced in troubleshooting Bendix full-vehicle wheel control AntiLock with traction control. It provides a quick reference to specific sections that provide testing procedures and values.



W5000553

COMPONENT TROUBLESHOOTING QUICK REFERENCE CHART

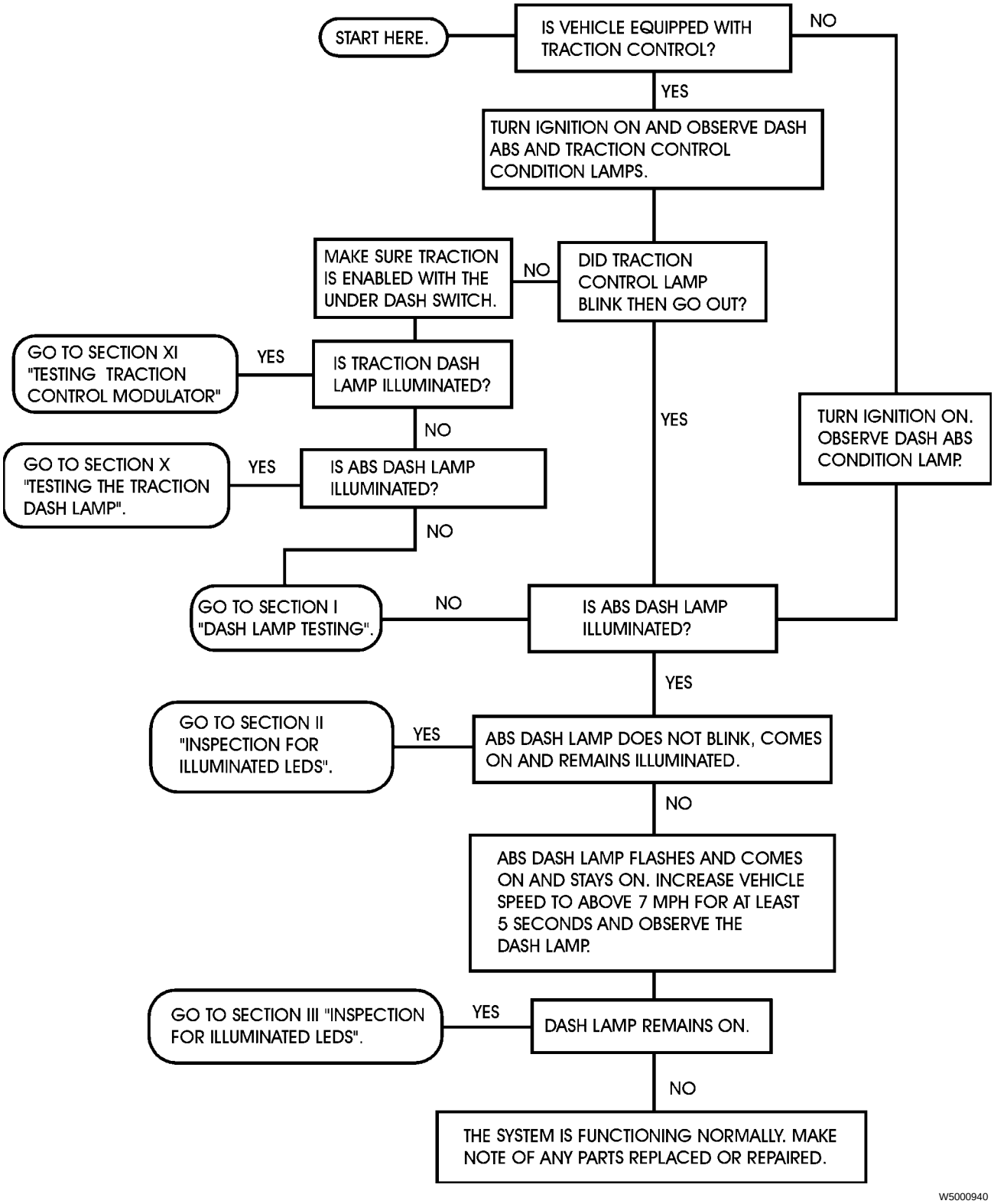
CHECK THE PINS SHOWN ON THE ECU 30-PIN CONNECTOR THAT CORRESPOND TO THE COMBINATION OF RED LEDs TO THE LEFT (ARROWS SHOW THE RED LED COMBINATION)



ALL CONTACTS ABOVE SHOULD NOT HAVE ANY CONTINUITY TO GROUND, PIN A1, A2, A3, OR J3 OF 30 PIN CONNECTOR
PIN B1, K2 & K3 ARE POWER TO ABS ECU

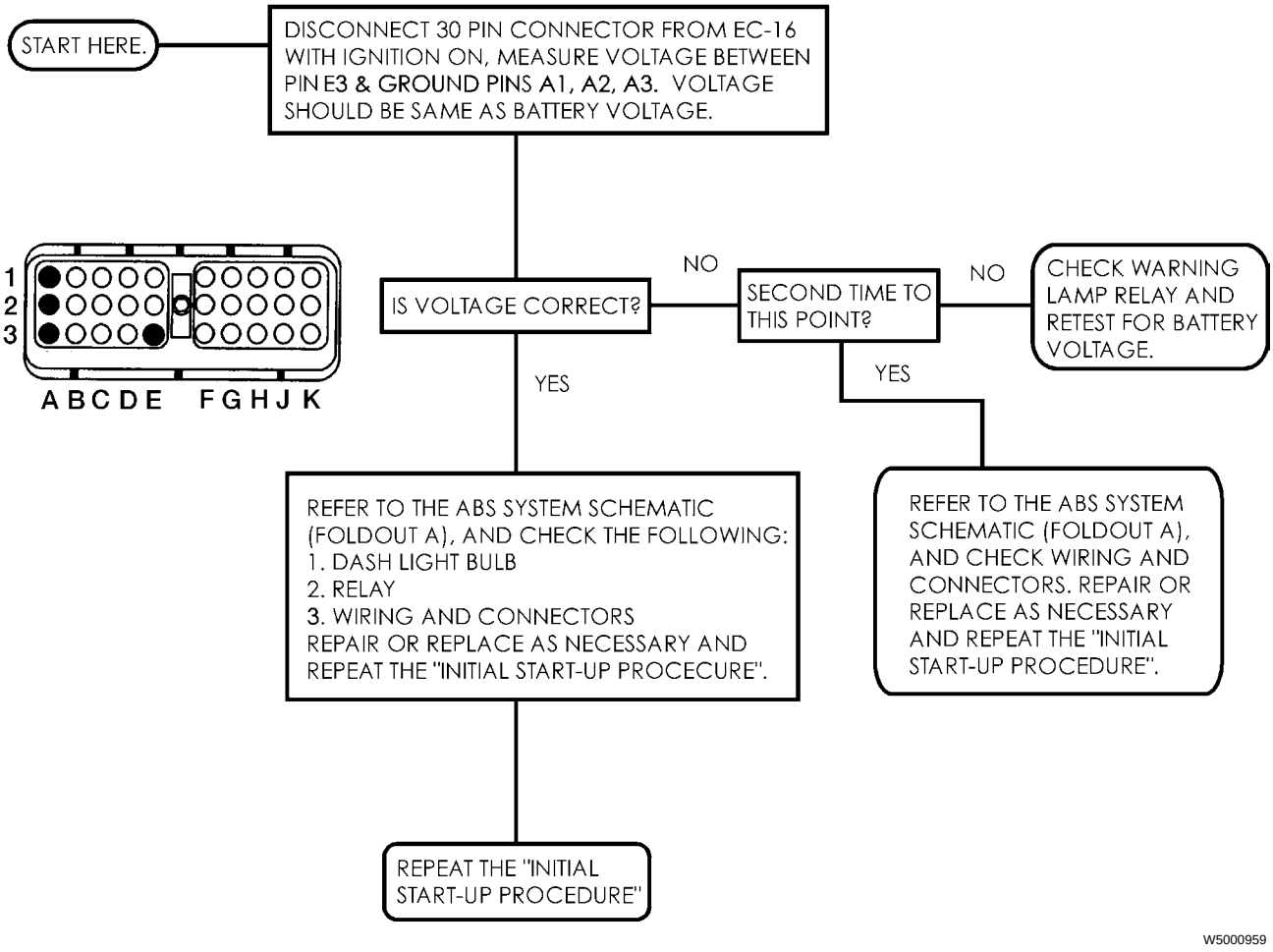
W5000967

INITIAL START-UP PROCEDURE



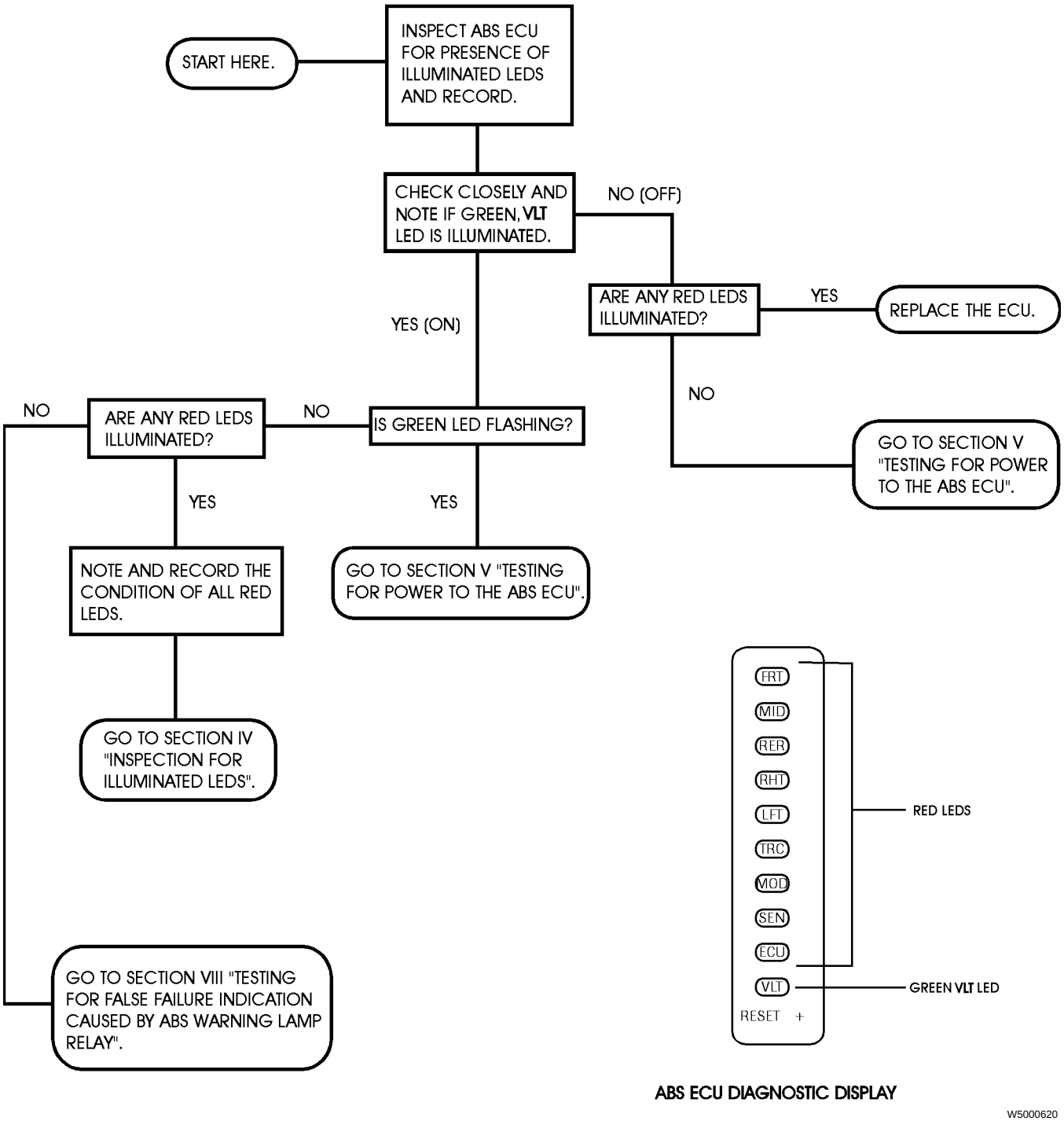
W5000940

SECTION I - ABS WARNING LAMP TESTING



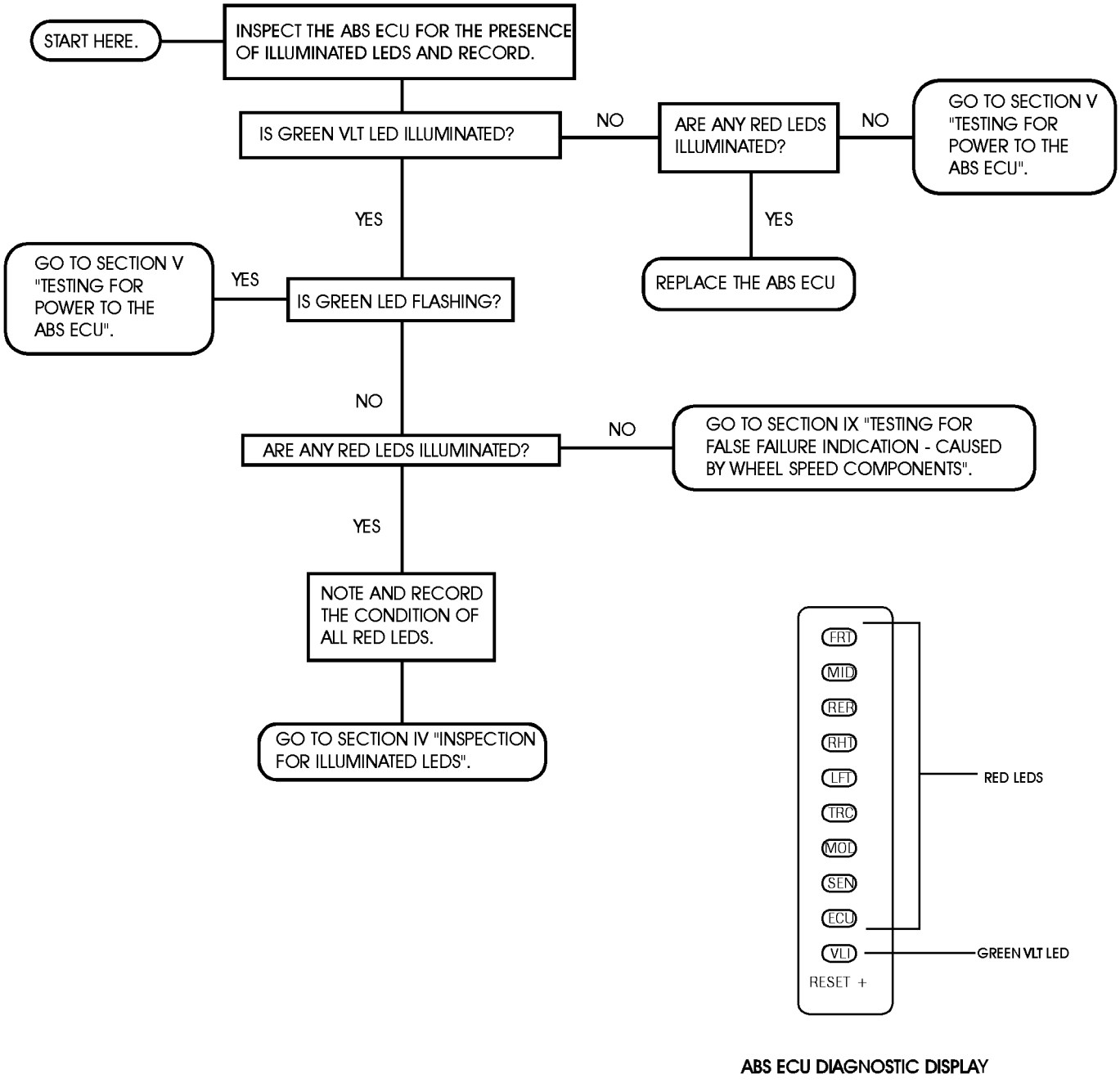
Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION II - INSPECTION FOR ILLUMINATED LEDS



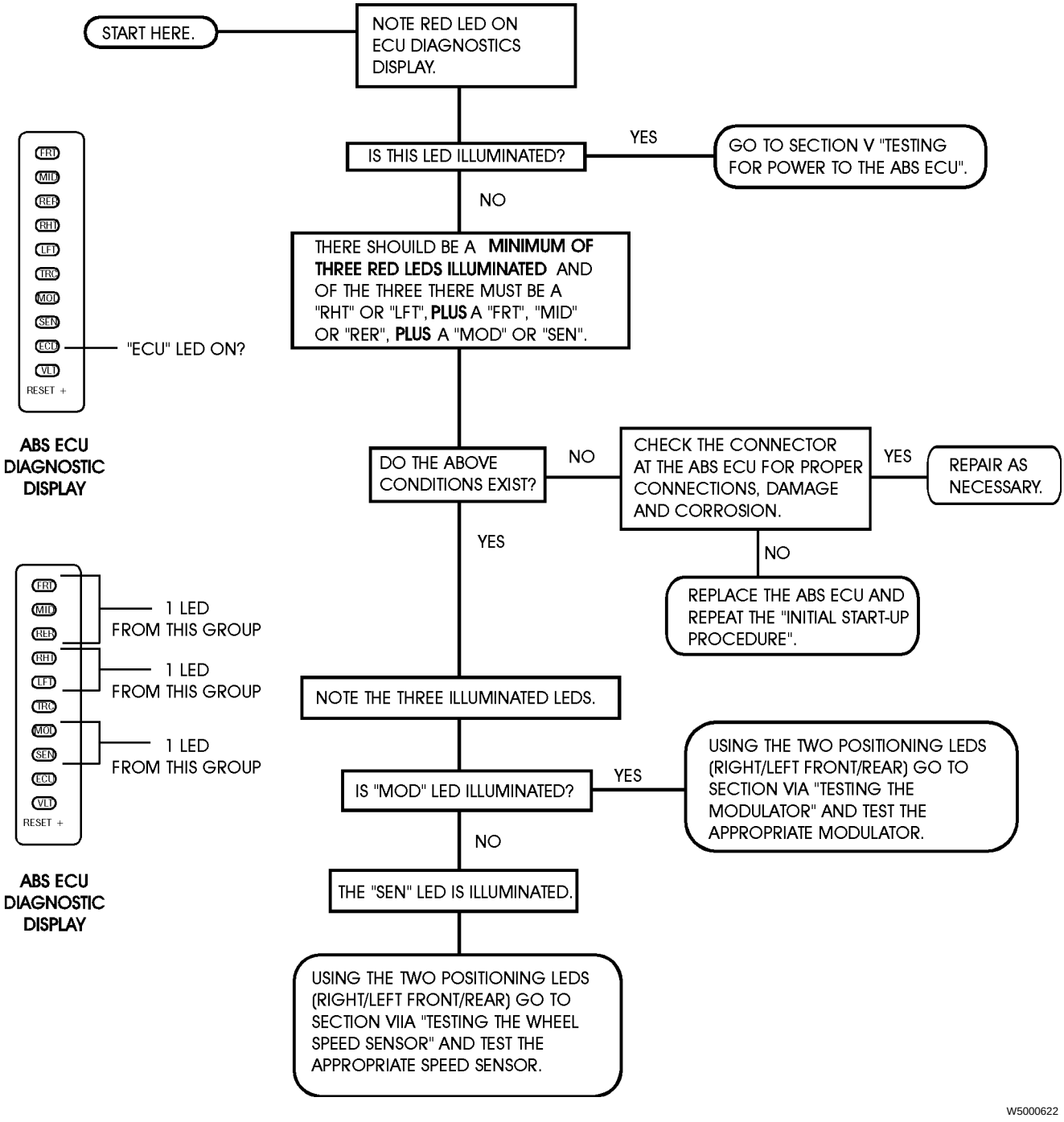
Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION III - INSPECTION FOR ILLUMINATED LEDS



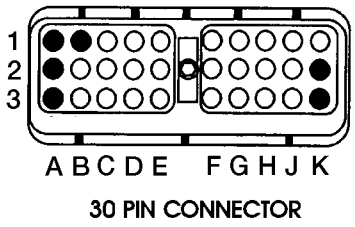
Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION IV - INSPECTION FOR ILLUMINATED LEDS



Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION V - TESTING FOR POWER TO THE ABS ECU



30 PIN CONNECTOR

START HERE

TURN IGNITION OFF. DISCONNECT 30-PIN CONNECTOR FROM ABS ECU. CHECK FOR PROPER CONNECTIONS, DAMAGE AND CORROSION.

TURN IGNITION ON AND MEASURE VOLTAGE BETWEEN BATTERY PINS **B1, K2, K3** AND GROUND PINS **A1, A2, A3** ON WIRE HARNESS CONNECTOR.

CAUTION: WHEN PROBING CONNECTOR TERMINALS, DO NOT INSERT PROBES INTO TERMINALS. THIS WILL SPREAD THE TERMINALS APART, CAUSING PERMANENT DAMAGE.

VOLTAGE SAME AS BATTERY VOLTAGE. MUST BE BETWEEN 11 AND 17 VOLTS.

NO

CHECK FOR FAILED 30 AMP FUSE.

YES

REPLACE.

NO

CHECK FOR FAILED ECU POWER RELAY.

YES

REPLACE.

NO

CHECK THE VEHICLE WIRING FOR CONTINUITY. REFER TO THE ABS SYSTEM SCHEMATIC (FOLDOUT A), AND CHECK THE BATTERY VOLTAGE AND GROUND SUPPLY. REPAIR AS NECESSARY AND RETEST.

YES

REPLACE THE ABS ECU.

REPEAT THE "INITIAL START-UP PROCEDURE".

W5000960

Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION VI A - TESTING THE MODULATOR VALVE

TURN IGNITION OFF. DISCONNECT 18- OR 30-PIN CONNECTOR FROM ABS ECU. CHECK FOR PROPER CONNECTIONS, DAMAGE AND CORROSION.

START HERE

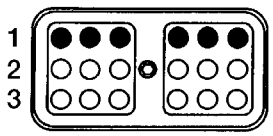
1. USING A DMM (DIGITAL MULTI- METER), FIRST CHECK THE CALIBRATION OF THE DMM BY TOUCHING THE LEADS TOGETHER. IF THERE IS A READING OTHER THAN ZERO, SUBTRACT IT FROM MEASUREMENTS MADE WITH THE DMM.
2. PROBE CONNECTOR WITH DMM TO CHECK RESISTANCE VALUES FOR MODULATOR BEING TESTED.

CAUTION: DO NOT INSERT PROBES INTO TERMINALS. THIS WILL SPREAD THE TERMINALS APART, CAUSING PERMANENT DAMAGE.

BENDIX M-22 RESISTANCE VALUES ARE LISTED BELOW.

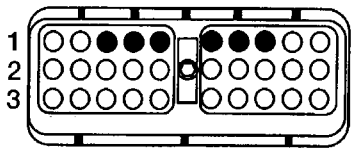
HOLD TO COMMON:	3.5 TO 5 OHMS
EXHAUST TO COMMON:	3.5 TO 5 OHMS
EXHAUST TO HOLD:	7 TO 10 OHMS
COMMON TO GROUND:	NO CONTINUITY
HOLD TO BATTERY POWER:	NO CONTINUITY
HOLD TO GROUND:	NO CONTINUITY
EXHAUST TO GROUND:	NO CONTINUITY

18 PIN CONNECTOR



F1	LEFT REAR MOD. COMMON
D1	LEFT REAR MOD. EXHAUST
E1	LEFT REAR MOD. HOLD
A1	RIGHT REAR MOD. COMMON
C1	RIGHT REAR MOD. EXHAUST
B1	RIGHT REAR MOD. HOLD

30 PIN CONNECTOR



H1	LEFT FRONT MOD. COMMON
F1	LEFT FRONT MOD. EXHAUST
G1	LEFT FRONT MOD. HOLD
C1	RIGHT FRONT MOD. COMMON
E1	RIGHT FRONT MOD. EXHAUST
D1	RIGHT FRONT MOD. HOLD

ARE RESISTANCE VALUES CORRECT?

YES

INSPECT CONNECTOR AND RECONNECT TO ABS ECU. TURN IGNITION ON AND PASS MAGNET OVER RESET ON ABS ECU. NOTE REACTION OF RED LEDS.

NO

GO TO SECTION VI **B** AND CONTINUE TESTING.

ARE ANY RED LEDS ILLUMINATED?

NO

REPEAT "INITIAL START-UP PROCEDURE". IF THIS STEP HAS REPEATED TWICE, **REPLACE THE ABS ECU.**

YES

SAME RED LEDS ILLUMINATED?

YES

REPLACE THE ABS ECU.

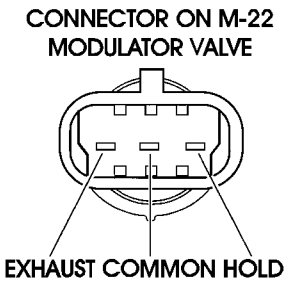
NO

GO TO SECTION IV "INSPECTION FOR ILLUMINATED LEDS" AND RETEST.

W5000961

Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION VI B - TESTING THE MODULATOR VALVE



START HERE FROM SECTION VI A

1. GO TO MODULATOR, DISCONNECT CONNECTOR AND CHECK FOR PROPER CONNECTIONS, DAMAGE AND CORROSION.

2. USING A DMM (DIGITAL MULTI-METER), FIRST CHECK THE CALIBRATION OF THE DMM BY TOUCHING THE LEADS TOGETHER. IF THERE IS A READING OTHER THAN ZERO, SUBTRACT IT FROM MEASUREMENTS MADE WITH THE DMM.

3. CHECK RESISTANCE BETWEEN PINS ON MODULATOR.

CAUTION: DO NOT INSERT PROBES INTO TERMINALS. THIS WILL SPREAD THE TERMINALS APART, CAUSING PERMANENT DAMAGE.

RESISTANCE VALUES FOR BENDIX M-22 MODULATOR:
HOLD TO COMMON: READ 3.5 TO 5 OHMS
EXHAUST TO COMMON: READ 3.5 TO 5 OHMS
EXHAUST TO HOLD: READ 7 TO 10 OHMS
TEST EACH PIN TO VEHICLE GROUND AND NOTE NO CONTINUITY.

RESISTANCE READINGS CORRECT?

NO → REPLACE THE MODULATOR.

YES

RECONNECT CONNECTOR TO MODULATOR. TURN IGNITION ON AND PASS MAGNET OVER RESET ON ABS ECU. NOTE REACTION OF RED LEDS.

ARE ANY RED LEDS ILLUMINATED?

NO → REPEAT THE "INITIAL START-UP PROCEDURE".

YES

SAME RED LEDS ILLUMINATED?

YES → CHECK CONTINUITY OF MODULATOR WIRE HARNESS. REPAIR OR REPLACE AS NECESSARY.

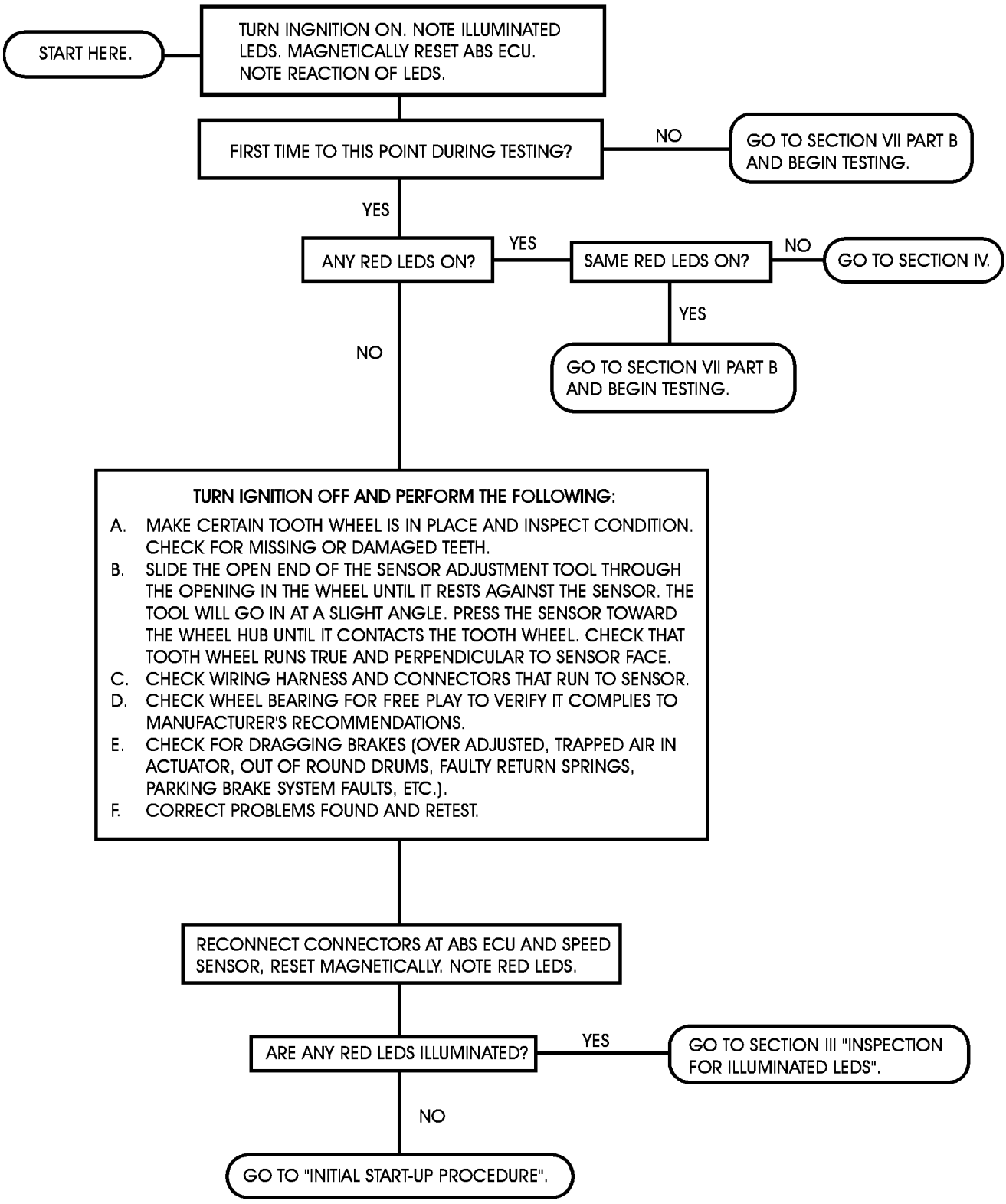
NO

GO TO SECTION IV "INSPECTION FOR ILLUMINATED LEDS" AND RETEST.

W5000625

Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION VII A - TESTING THE WHEEL SPEED SENSOR



W5000626

Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION VII B - TESTING THE WHEEL SPEED SENSOR

START HERE FROM SECTION VII A.

SAME LEDS ILLUMINATED?

NO → GO TO SECTION III "INSPECTION FOR ILLUMINATED LEDS".

YES

TURN IGNITION OFF. REMOVE CONNECTOR FROM ABS ECU. CHECK FOR PROPER CONNECTIONS, DAMAGE AND CORROSION.

USING A DMM, FIRST CHECK THE CALIBRATION OF THE DMM BY TOUCHING THE LEADS TOGETHER. IF THERE IS A READING OTHER THAN ZERO, SUBTRACT IT FROM MEASUREMENTS MADE WITH THE DMM.

MEASURE RESISTANCE BETWEEN THE APPROPRIATE SPEED SIGNAL (+) AND SIGNAL RETURN (-). RESISTANCE FOR BENDIX WS-20 IS BETWEEN 1500-2500 OHMS.

CAUTION: DO NOT INSERT PROBES INTO TERMINALS. THIS WILL SPREAD THE TERMINALS APART, CAUSING PERMANENT DAMAGE.

CHECK CONTINUITY BETWEEN POWER (B1, K2,3) AND SPEED SIGNAL, THEN BETWEEN GROUND (A1,2,3) AND SPEED SIGNAL. NO CONTINUITY PERMITTED.

CORRECT RESISTANCE?

YES → REPLACE THE ABS ECU.

NO

DISCONNECT CONNECTOR AT SPEED SENSOR. CHECK FOR PROPER CONNECTIONS, DAMAGE, OR CORROSION, THEN CHECK THE RESISTANCE BETWEEN TWO PINS ON SENSOR USING PINOUT CABLE (SEE "SYSTEM CHECK"). RESISTANCE SHOULD BE BETWEEN 1500-2500 OHMS FOR THE BENDIX WS-20.
CHECK CONTINUITY BETWEEN POWER (B1,K2,3) AND SPEED SIGNAL, THEN BETWEEN GROUND (A1,2,3) AND SPEED SIGNAL. NO CONTINUITY PERMITTED.

NO → REPLACE THE SENSOR.

YES

RECONNECT CONNECTOR AT SPEED SENSOR AND ABS ECU. RESET ECU MAGNETICALLY. NOTE IF ANY RED LEDS ARE ILLUMINATED.

ARE ANY LEDS ILLUMINATED?

NO → REPEAT THE "INITIAL START-UP PROCEDURE".

YES

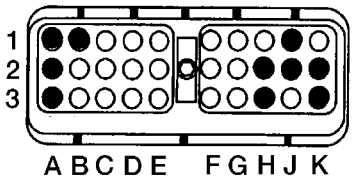
ARE SAME RED LEDS ILLUMINATED?

NO → GO TO SECTION III "INSPECTION FOR ILLUMINATED LEDS".

YES

CHECK CONTINUITY ON SPEED SENSOR WIRING HARNESS. REPAIR OR REPLACE AS NECESSARY.

30 PIN CONNECTOR

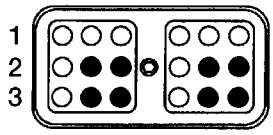


J2 LEFT FRONT W.S. RTN.
J1 LEFT FRONT W.S. SIGNAL

H3 RIGHT FRONT W.S. RTN.
H2 RIGHT FRONT W.S. SIGNAL

A1,2,3 GROUND
B1,K2,3 POWER

18 PIN CONNECTOR



C3 LEFT MID W.S. RTN.
C2 LEFT MID W.S. SIGNAL

F3 LEFT REAR W.S. RTN.
F2 LEFT REAR W.S. SIGNAL

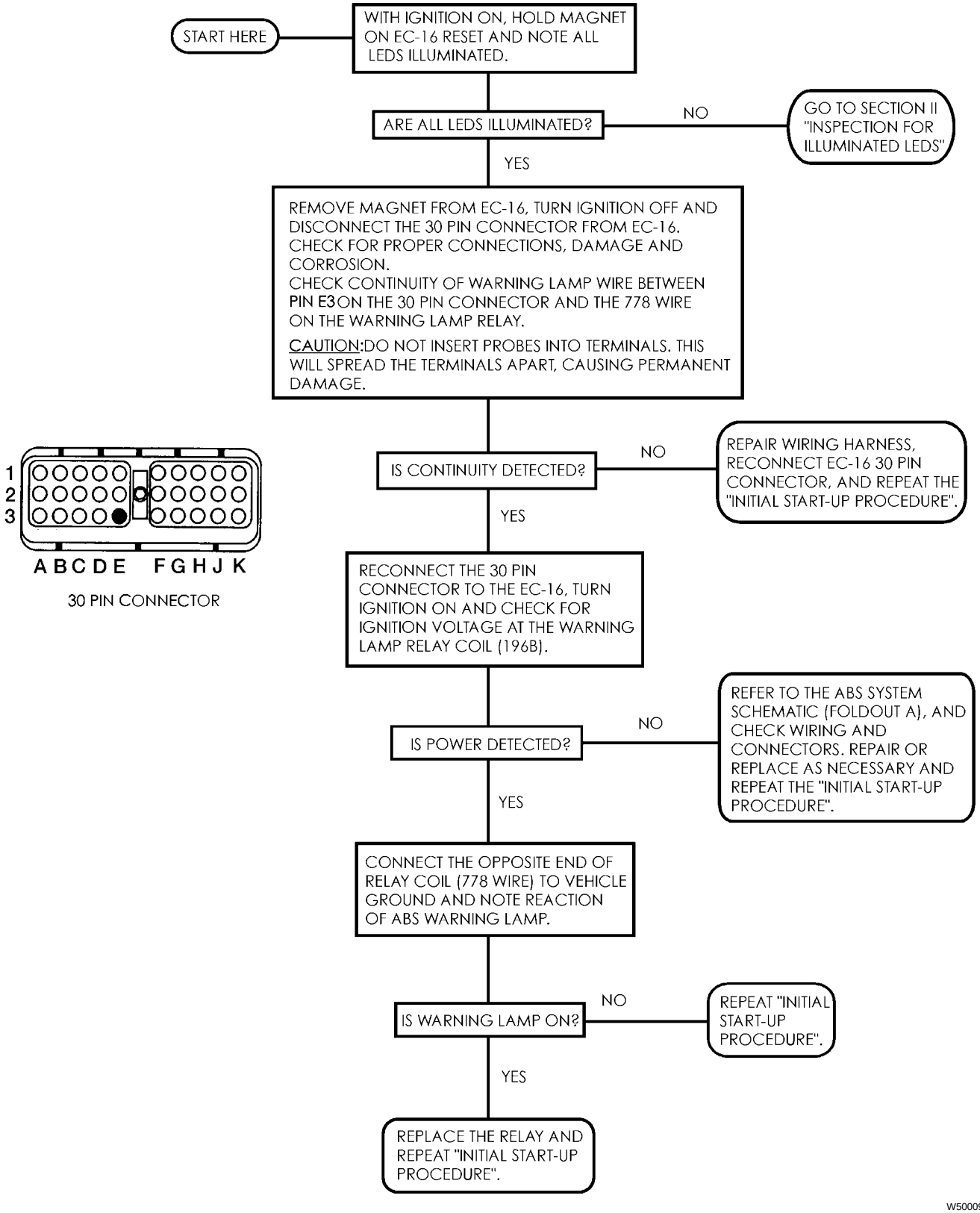
B3 RIGHT MID W.S. RTN.
B2 RIGTH MID W.S. SIGNAL

E3 RIGHT REAR W.S. RTN.
E2 RIGHT REAR W.S. SIGNAL

W5000968

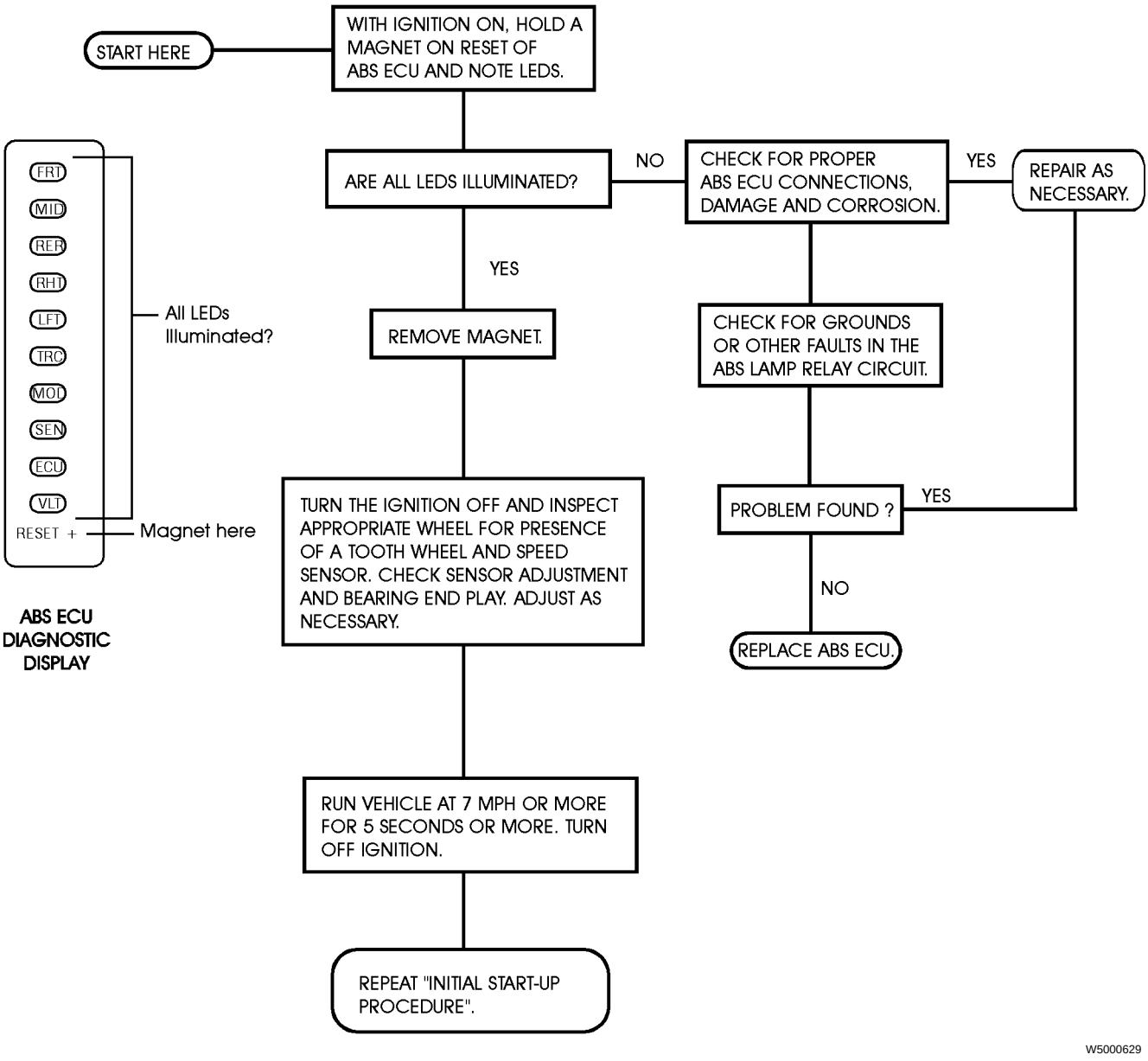
Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION VIII - TESTING FOR FALSE INDICATION CAUSED BY ABS WARNING LAMP RELAY



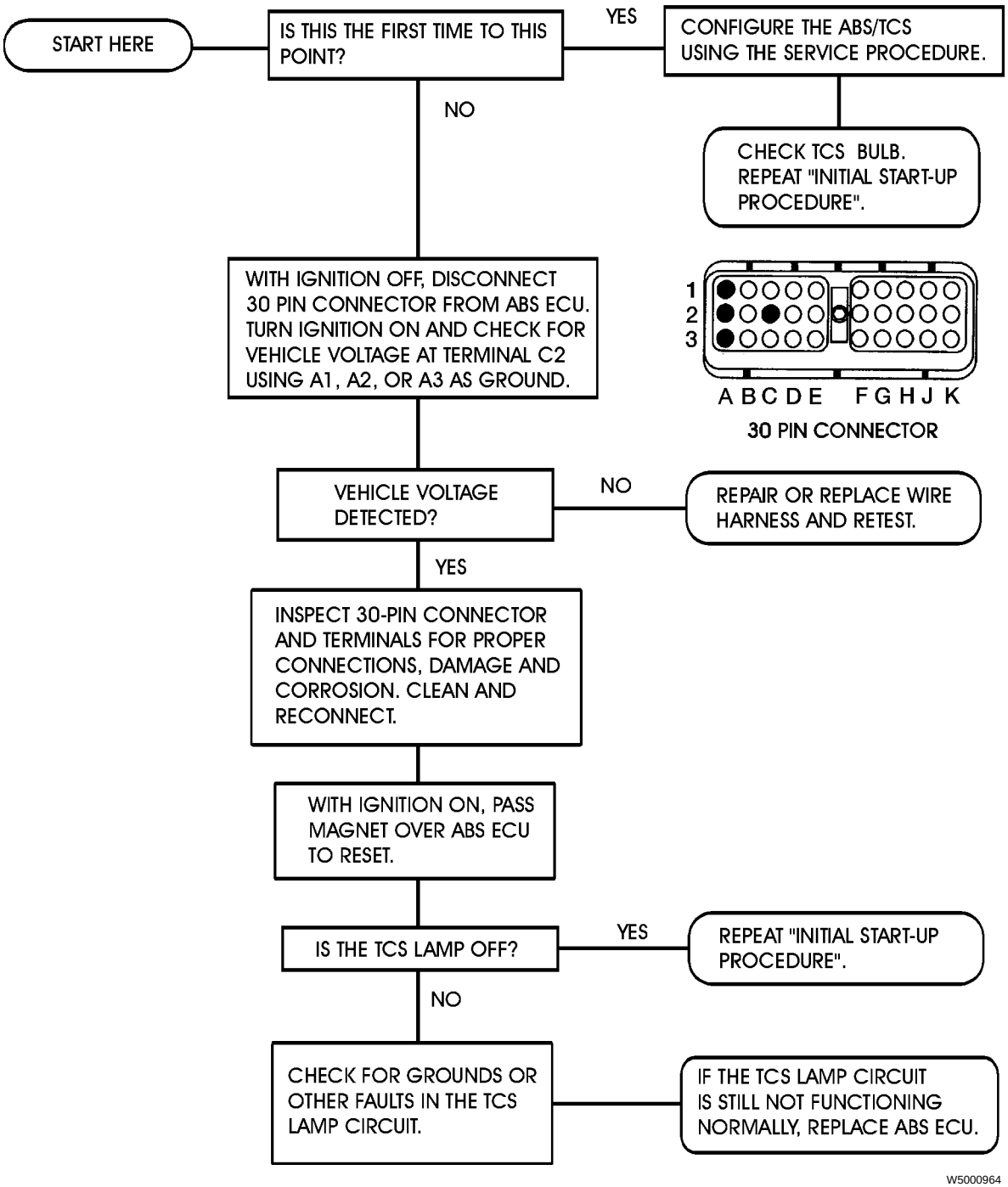
Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION IX - TESTING FOR FALSE INDICATION CAUSED BY WHEEL SPEED COMPONENTS



SECTION X - TESTING TCS LAMP

NOTE: VEHICLES WITH TRACTION CONTROL ARE EQUIPPED WITH A TCS DISABLE SWITCH. MAKE CERTAIN THIS SWITCH IS NOT IN THE OFF POSITION BEFORE BEGINNING TROUBLESHOOTING.



Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION XI - TESTING TRACTION CONTROL VALVE

START HERE

WITH IGNITION ON, INSPECT EC-16 FOR ILLUMINATED LEDS.

IS "TRC" LED ONLY ON?

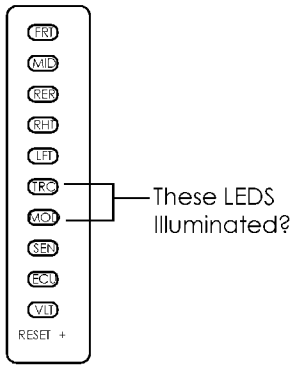
YES

GO TO SECTION XII "TESTING ENGINE CONTROL MODULE WIRE HARNESS".

NO

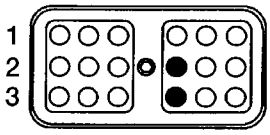
ARE "TRC" AND "MOD" LEDS ON?

YES



TURN IGNITION OFF AND DISCONNECT 18 PIN CONNECTOR FROM EC-16. CHECK FOR PROPER CONNECTIONS, DAMAGE AND CORROSION.
USING A DMM (DIGITAL MULTI-METER), FIRST CHECK THE CALIBRATION OF THE DMM BY TOUCHING THE LEADS TOGETHER. IF THERE IS A READING OTHER THAN ZERO, SUBTRACT IT FROM MEASUREMENTS MADE WITH THE DMM. CHECK RESISTANCE BETWEEN PINS D2 & D3. RESISTANCE SHOULD BE 10 - 12 OHMS. REMOVE 30 PIN CONNECTOR AND CHECK CONTINUITY BETWEEN GROUND (A1,2,3) AND D2 & D3. NO CONTINUITY PERMITTED.

CAUTION: DO NOT INSERT PROBES INTO TERMINALS. THIS WILL SPREAD THE TERMINALS APART, CAUSING PERMANENT DAMAGE.



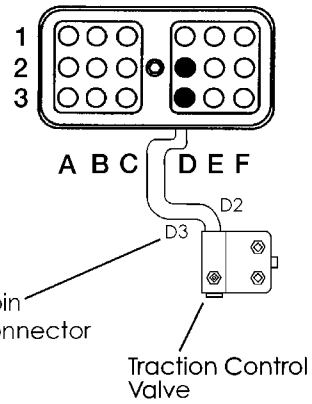
18 PIN CONNECTOR

CHECK CONDITION OF 18 PIN CONNECTOR. CLEAN, RECONNECT, TURN IGNITION ON & PASS MAGNET OVER EC-16 RESET. REPEAT "INITIAL START-UP PROCEDURE".

YES

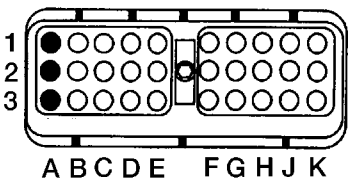
RESISTANCE CORRECT & NO CONTINUITY TO GROUND?

NO



DISCONNECT 2 PIN CONNECTOR AT TRACTION CONTROL VALVE & CHECK RESISTANCE OF CONNECTOR HALF ATTACHED TO TRACTION CONTROL VALVE. RESISTANCE SHOULD BE 10 - 12 OHMS. THEN CHECK CONTINUITY BETWEEN GROUND ON 30 PIN CONNECTOR (A1,2,3) AND BOTH PINS ON THE 2 PIN CONNECTOR LEADING TO THE TRACTION CONTROL VALVE. NO CONTINUITY PERMITTED.

30 PIN CONNECTOR



A1 GROUND
A2 GROUND
A3 GROUND

REPLACE TRACTION CONTROL VALVE

NO

RESISTANCE CORRECT & NO CONTINUITY TO GROUND?

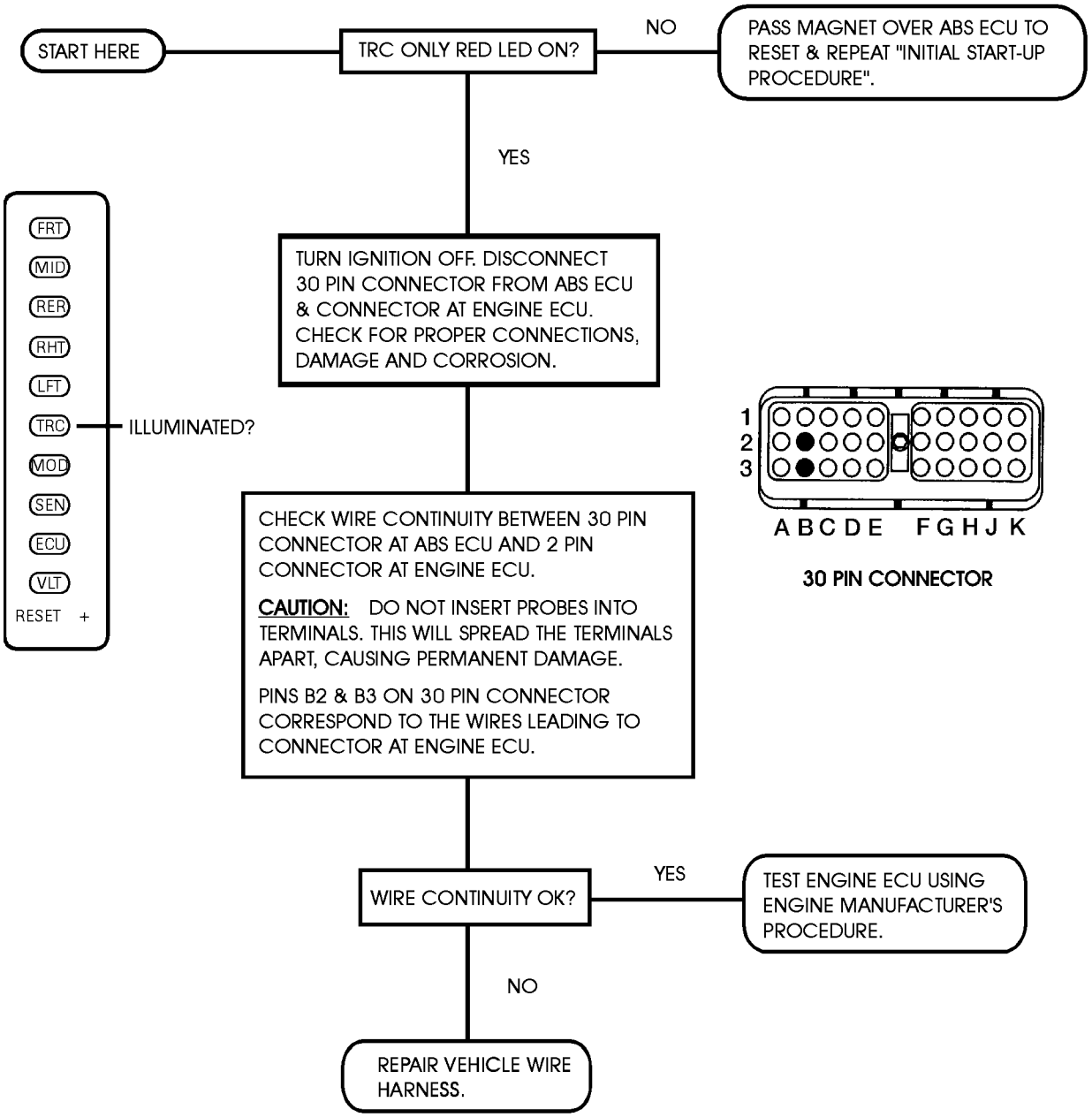
YES

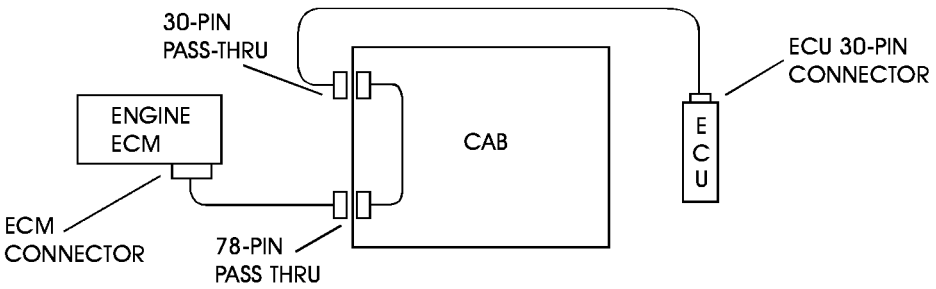
REPAIR WIRE HARNESS (FROM 18 PIN CONNECTOR TO 2 PIN CONNECTOR).

W5000965

Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

SECTION XII - TESTING J1922 CIRCUIT





J1922 ROUTING

W5000966

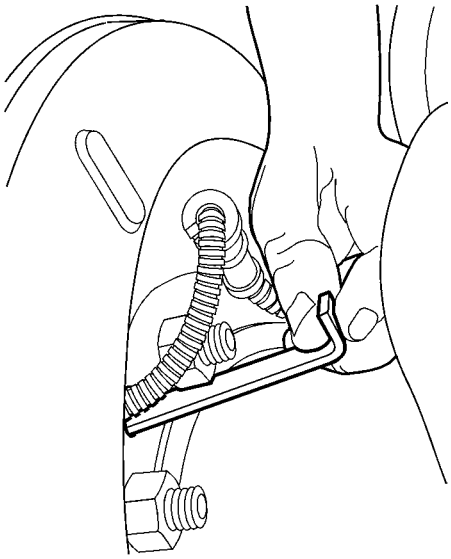
Note: For more detailed information, refer to Electrical Wiring and Circuit Diagrams

Service Procedures

ABS Sensor Adjustment

Special tools: J-42942

1



W5000941

Slide the notched end of the sensor adjustment tool J-42942 through the opening in the brake spider until it rests against the sensor (the tool will go in the hole at a slight angle). J-42942

Note: It is not necessary to remove the wheel or drum to adjust sensors using the adjustment tool.

CAUTION

Potential sensor damage. DO NOT use a screwdriver or sharp instrument to adjust sensor. Use of sharp instrument could permanently damage sensor.

2

CAUTION

Potential sensor damage. DO NOT use a hammer to drive the sensor into position. Hammering the sensor could cause the sensor to be inoperative.

Press the sensor toward the wheel hub until the sensor contacts the tooth wheel.

3

Remove the sensor adjustment tool.

4

Verify proper sensor adjustment by driving the vehicle. This allows the ABS to perform an additional self test (see “ABS Self Tests” page 22). Once the vehicle reaches approximately 11 km/h (7 mph), the ABS warning lamp will go out if the sensor is properly adjusted.

Front Axle Sensor Replacement

Removal

DANGER

PERSONAL INJURY HAZARD! Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

DANGER

Do not work under a vehicle supported only by jacks. Jacks can slip out from under the truck or fall over, causing personal injury or death. Always use jack stands under the truck.

1
Park the vehicle on a level surface, apply the parking brake, and block the rear wheels. Ensure vehicle ignition is OFF and transmission is in neutral.

2
Raise the tire with the sensor to be replaced off the ground. Place jack stands under the axle.

3
Back off the slack adjuster to release the brake shoes.

4
Remove the wheel from the axle.

5
Remove the brake drum.

6

CAUTION

Possible sensor damage. DO NOT pull on the sensor cable in order to remove it. This may damage the sensor.

Using a slight twisting motion, remove the sensor from its mounting block.

Note: It may be necessary to wedge a screwdriver between the tooth wheel and the sensor in order to loosen it from its mounting block. Use extreme care not to damage the tooth wheel or the sensor.

7
Remove the sensor spring clip from the mounting block.

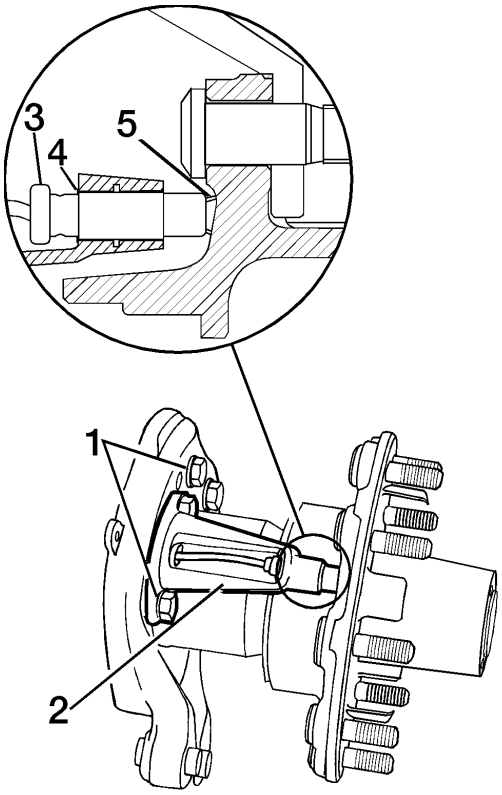
8
Cut any cable ties that hold the sensor cable to the brake chamber hose or frame components.

9
Disconnect the sensor from the vehicle wiring at the connector closest to the sensor.

10
Pull the sensor cable through the hole in the frame rail.

Installation

1



W5000635

1) Spider mounting bolts
2) Sensor bracket
3) Sensor
4) Spring clip
5) Tooth wheel

Note: Spring clip must be installed with the flange stops facing the inboard side of the vehicle.

Push the sensor spring clip all the way into the mounting block.

2
Insert the sensor cable through the hole in the spindle and spider assembly. Pull the cable until the sensor is at the hole. Route the remaining cable and connector through the frame rail.

3

⚠ CAUTION

Potential sensor damage. DO NOT us a screwdriver or sharp instrument to insert sensor. Use of a sharp instrument could cause sensor damage.

Using the sensor tool press the sensor into the spring clip and mounting block. Press the sensor toward the wheel hub until the sensor contacts the tooth wheel.

4
Connect the sensor cable to the chassis harness. Secure the connection with a cable tie.

5
Fasten the sensor cable to the brake chamber hose using a cable tie. Install additional ties as necessary to hold sensor cable in place.

6
Install the brake drum.

7
Adjust the brakes.

8
Install the wheel and tighten the wheel nuts.

9
Remove the jack stand(s) from under the vehicle.

10
Lower the vehicle and remove the wheel blocks.

11
Verify proper sensor adjustment by driving the vehicle. This allows the ABS to perform an additional self test (see “ABS Self Tests” page 22). Once the vehicle reaches approximately 11 km/h (7 mph), the ABS warning lamp will go out if the sensor is properly adjusted.

Rear Axle Sensor Replacement

Removal

⚠ DANGER

PERSONAL INJURY HAZARD! Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

1
Park the vehicle on a level surface, apply the parking brake, and block the front wheels. Ensure the vehicle ignition is OFF and transmission is in neutral.

2
Raise the tire with the sensor to be replaced off the ground. Place jack stands under the axle.

3
Release the parking brake and back off the slack adjuster to release the brake shoes.

4
Remove the wheel from the axle.

5
Remove the brake drum.

6

⚠ CAUTION

Possible sensor damage. DO NOT pull on the sensor cable in order to remove it. This may damage the sensor.

Note: It may be necessary to wedge a screwdriver between the tooth wheel and the sensor in order to loosen it from its mounting block. Use extreme care not to damage the tooth wheel or the sensor.

Using a slight twisting motion, remove the sensor from its mounting block.

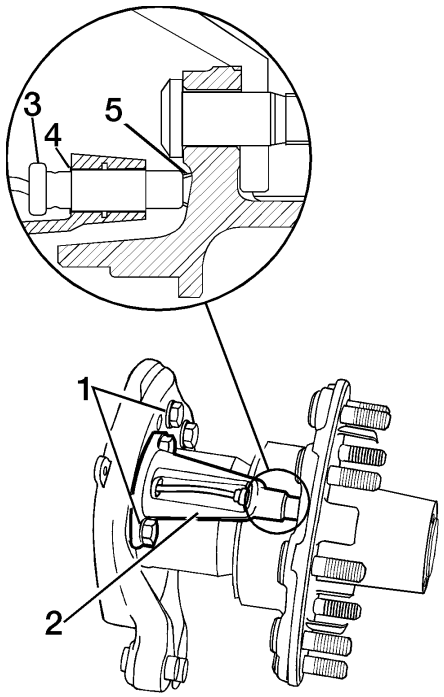
7
Remove the sensor spring clip from the mounting block.

8
Disconnect any cable ties that hold the sensor to the brake chamber hose or frame components.

9
Disconnect the sensor cable from the chassis harness.

Installation

1



W5000635

1) Spider mounting bolts
2) Sensor bracket
3) Sensor
4) Spring clip
5) Tooth wheel

Note: Spring clip must be installed with the flange stops facing the inboard side of the vehicle.

Push the sensor spring clip all the way into the mounting block.

2
Insert the sensor cable through the hole in the spider. Route the cable to the frame rail.

3

CAUTION

Potential sensor damage. **DO NOT** us a screwdriver or sharp instrument to insert sensor. Use of a sharp instrument could cause sensor damage.

Using the ABS sensor tool (see “ABS Sensor Adjustment” page 63), press the sensor into the spring clip and mounting block. Press the sensor toward the hub until it contacts the tooth wheel.

4
Connect the sensor cable to the chassis harness. Secure the connection with a cable tie.

5
Fasten the sensor cable to the brake chamber hose using a cable tie. Install additional ties as necessary to hold the sensor cable in place.

6
Install the brake drum.

7
Adjust the rear axle brakes.

8
Install the wheel and tighten the wheel nuts.

9
Remove the jack stand(s) from under the vehicle.

10
Lower the vehicle and remove the wheel blocks.

11
Verify proper sensor adjustment by driving the vehicle. This allows the ABS to perform an additional self test (see “ABS Self Tests” page 22). Once the vehicle reaches approximately 11 km/h (7 mph), the ABS warning lamp will go out if the sensor is properly adjusted.

Front Modulator Valve Replacement

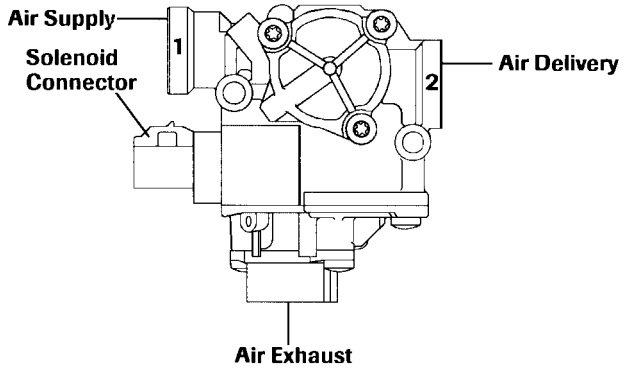
DANGER

PERSONAL INJURY HAZARD! Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Removal

1
Park the vehicle on a level surface, apply the parking brake, and block the wheels. Ensure the vehicle ignition is OFF and transmission is in neutral.

2

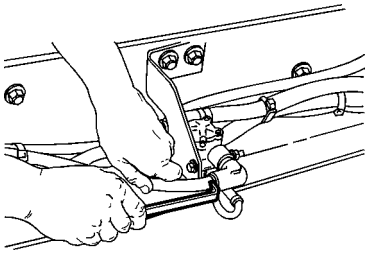


W5000534

Disconnect the electrical connector from the valve.

3
Identify and label or mark modulator valve air lines for later reinstallation.

4



W5000956

Using the air filter removal tool, disconnect the air supply and delivery lines from the valve.

5
Remove the valve mounting screws and nuts.

6
Remove the valve.

7
Note the orientation of the fittings in the valve, then remove the fittings.

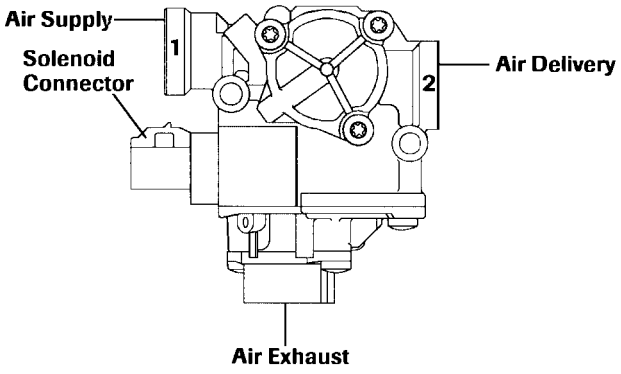
Installation

1
Install the proper fittings on the valve in the original orientation. Use tape or paste-type thread sealant on fittings to reduce the probability of leakage.

2
Mount the valve on the vehicle using two bolts and nuts. Torque the nuts to 24 Nm (18 ft-lb).

24 Nm (18 ft-lb)

3



W5000534

Connect the air supply line to port 1 of the valve. Connect the delivery line to port 2.

4
Connect the modulator valve electrical connector.

5
Build up air pressure in the vehicle's air system.

6
Release the parking brakes.

7
Apply normal brake pressure and verify that the air passes freely through the ABS modulator valve and that there are no air leaks.

Rear Modulator Valve Replacement

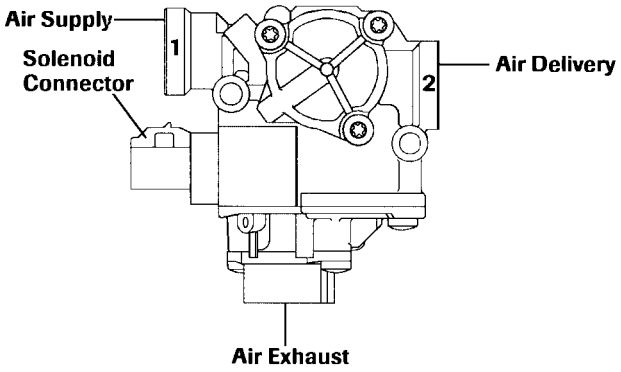
Removal

DANGER

PERSONAL INJURY HAZARD! Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

1
Park the vehicle on a level surface, apply the parking brake, and block the wheels. Ensure vehicle ignition is OFF and transmission is in neutral.

2



W5000534

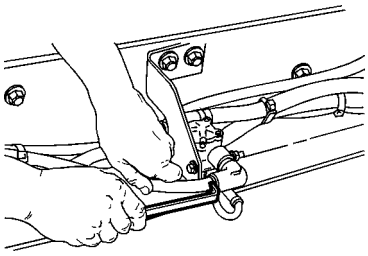
Disconnect the electrical connector from the valve.

3
Identify and label or mark modulator valve air lines to facilitate installation.

4
Remove the air line(s) from the service brake chamber(s) supplied by the valve. Remove the P-clips and plastic tie straps that hold the air line(s) in place.

Note: Due to the non-rotating fittings at the valve, the service brake chamber air line(s) must be removed with the valve.

5



W5000956

Using the air filter removal tool, disconnect the supply air line that comes from the relay valve.

6
Remove the valve mounting screws and nuts.

7
Remove the valve.

8
Remove the two service brake chamber airline(s) from the valve.

9
Note the orientation of the fittings in the valve, then remove the fittings.

Installation

1
Install the proper fittings on the valve in the original orientation. Use tape or paste-type thread sealant on fittings to reduce the probability of leakage.

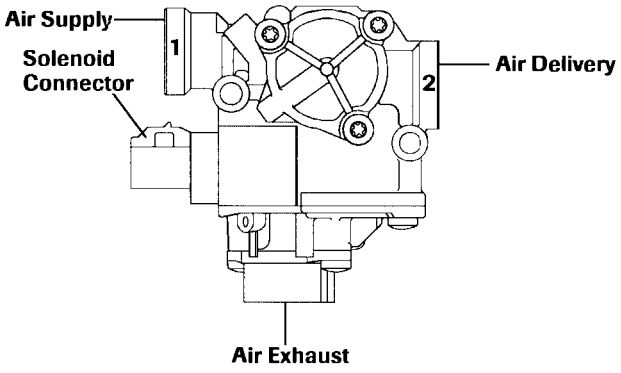
2
Connect the air line(s) for the service brake chamber(s) to the valve.

3
Route the service brake chamber air line(s) through the frame and to the service brake chamber(s). Connect the air line(s) to the chamber(s). Install the P-clips and tie straps to hold the air line(s) in place.

4
Mount the valve on the vehicle using two bolts and nuts. Torque the nuts to 24 Nm (18 ft-lb).

24 Nm (18 ft-lb)

5



W5000534

Connect the supply line from the relay valve to port 1 of the modulator valve.

6
Connect the valve electrical connector.

7
Build up air pressure in the vehicle's air system.

8
Release the parking brakes.

9
Apply normal brake pressure and verify that the air passes freely through the ABS modulator valve and that there are no air leaks.

ATR Valve Replacement

DANGER

PERSONAL INJURY HAZARD! Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

Removal

1
Park the vehicle on a level surface, apply the parking brake, and block the wheels. Ensure the vehicle ignition is OFF and the transmission is in neutral.

2

DANGER

Components in any air brake system may be under high pressure. Before disconnecting any air lines, be sure all air pressure is released. Failure to do so may result in the sudden, possibly explosive release of air pressure, causing parts to strike you with considerable force, resulting in serious personal injury.

Bleed the air pressure from the vehicle's air brake system.

3
Identify and label or mark the ATR valve air lines for proper reinstallation.

4
Disconnect the electrical connector from the valve.

5
Disconnect the air lines from the valve.

6
Remove the valve mounting bolts and nuts.

7
Remove the valve.

8
Note the orientation of the fittings in the valve, then remove the fittings.

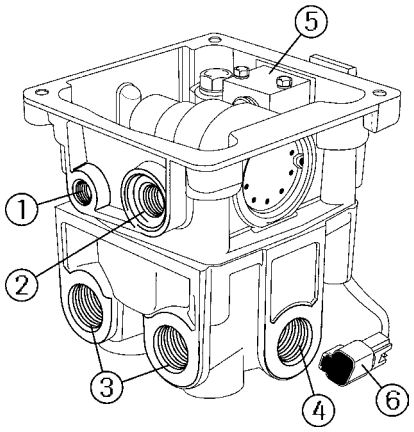
Installation

1
Install the proper fittings on the valve in the original orientation. Use tape or paste type thread sealant on fittings to reduce the probability of leakage.

2
Mount the valve on the vehicle using two cap screws and nuts. Torque the nuts to 24 Nm (18 ft-lb).

24 Nm (18 ft-lb)

3



W5000536

Connect the air supply lines to the ATR valve as follows:

a) Control air line to port 1
b) Service air line to port 2
c) Delivery air line to port 3
d) Supply line to port 4

4
Connect the valve electrical connector.

5
Build up air pressure in the vehicle's air system.

6
Release the parking brakes.

7
Apply air pressure to the service brakes and verify that there are no air leaks and that the system is working properly.

ABS Electronic Control Unit Replacement

Removal

1
Ensure the vehicle ignition is OFF.

2
Disconnect all connectors from the ECU.

3
Unbolt the ECU mounting bracket from the vehicle by removing the two mounting nuts from the front of the crossmember. Remove the ECU and bracket.

4
Remove the four bolts and nuts that hold the ECU to its bracket.

Installation

1
Verify the vehicle ignition is OFF.

2
Bolt the replacement ECU to its mounting bracket. Torque the bolts to 7.3 ± 1.7 Nm (65 ± 15 in-lb).

7.3 ± 1.7 Nm (65 ± 15 in-lb)

3
Install the ECU mounting bracket on the crossmember and install the mounting nuts. Torque the bolts to 24 ± 4 Nm (213 ± 36 in-lb).

24 ± 4 Nm (213 ± 36 in-lb)

4
Connect all electrical connectors to the ECU. Torque the connector screws to 1.15 ± .35 Nm (10 ± 3 in-lb).

1.15 ± .35 Nm (10 ± 3 in-lb)

5
Turn the vehicle ignition to ON.

6
Place the TCS switch to OFF.

7
Configure the ECU by holding a magnet over the point labeled RESET on the LED side of the ECU for at least 20 seconds.

Note: The LEDs will flash while self-configuration is taking place. Power should not be removed from the ECU during self-configuration.

8
Verify that the LEDs flash to indicate self-configuration is occurring.

9
When self-configuration is complete, verify the ECU carries out its normal power on sequence as listed below.

a. All LEDs ON

b. All LEDs OFF

c. SEN, FRT, and RER LEDs ON

d. TRC LED ON (if J1922 engine control is enabled)

e. TRC and MOD LEDs ON (if differential braking is enabled)

f. LEDs indicate actual fault status

10
If the LEDs indicate there are faults in the system, troubleshoot them in accordance with the troubleshooting procedure (see “Troubleshooting” page 25) and make any required repairs.

System Check

Function Checks

Note: Unless otherwise stated, there must be air pressure in the brake system to perform the valve tests described below.

Traction Control Valve Function Check

DANGER

PERSONAL INJURY HAZARD! Before working on a vehicle, set the parking brakes, place the transmission in neutral, and block the wheels. Failure to do so can result in unexpected vehicle movement and can cause serious personal injury or death.

DANGER

PERSONAL INJURY HAZARD! Never disconnect an air system component unless all system pressure has been depleted. Failure to deplete system pressure before disconnecting hoses or components may result in them separating violently and causing serious bodily injury or death.

DANGER

PERSONAL INJURY HAZARD! Exhaust gases contain deadly poison. When testing a vehicle with the engine running, conduct the test outdoors or use a properly vented exhaust hose.

1 Drain air pressure from all vehicle reservoirs.

2 Install a tee at the traction control valve service port and one of the delivery ports. Connect a test gauge at each tee.

3 Connect the tractor service and emergency glad hands to dummy connectors or to a trailer.

4 Start the vehicle and build system air pressure to normal.

5 Make 5 full brake applications and check the test gauge fittings for leaks. Tighten if necessary.

6 Activate the system park control and trailer supply dash control valves for tractor/trailer operation.

Note: If any of the desired results for the tests below are not met the valve should be repaired or replaced.

7 Apply and release the brakes several times checking for prompt application and release at each wheel.

8 If prompt application and complete release occurs at some but not all wheels, test the ABS modulator valve (M–22) between the traction control valve and the brake actuator.

9 If a sluggish response or incomplete release is noted at all wheels, inspect for system leakage or a kinked or obstructed air line leading to or from the traction control valve.

10 Apply and hold a full pressure brake application and make sure that full pressure is delivered to the brake chambers.

11 Set the dash mounted trailer air supply valve for bobtail tractor operation (Yellow knob OUT).

12 Make a slow brake application up to 20 psi at the traction control valve service port while observing the pressure at the delivery port. Verify that the delivery port pressure rises to 5 to 10 psi (.34 to .69 bar).

13 Release the brakes.

14 Make a slow brake application up to 60 to 70 psi (4.14 to 4.83 bar) at the traction control valve service port while observing the pressure at the delivery port. Verify that the delivery port pressure rises to 20 to 25 psi (1.38 to 1.72 bar).

Note: Delivery pressure should be approximately one-third of service pressure.

15 Release the brakes.

16 Make a full brake application and verify both service and delivery pressures register the same pressure.

17 If differential pressure test is not to be performed, deplete the air from the system, remove the test gauges, and restore the system to normal.

Traction Control Valve Differential Pressure Check

1 Apply 10 psi pressure to the traction control valve service port. Note the pressure at the delivery port.

2 Subtract the delivery port value from 10 psi. This is the differential pressure.

3 Verify the differential pressure is correct for the valve part number. If it is incorrect, the valve should be repaired or replaced.

4 Deplete the air from the system and remove the test gauges.

5 Restore the system to normal.

Traction Control Valve Solenoid Check

1 Disconnect the two pin solenoid connector from the wire harness.

2 Measure the solenoid coil resistance. Verify it is 10 to 12 ohms.

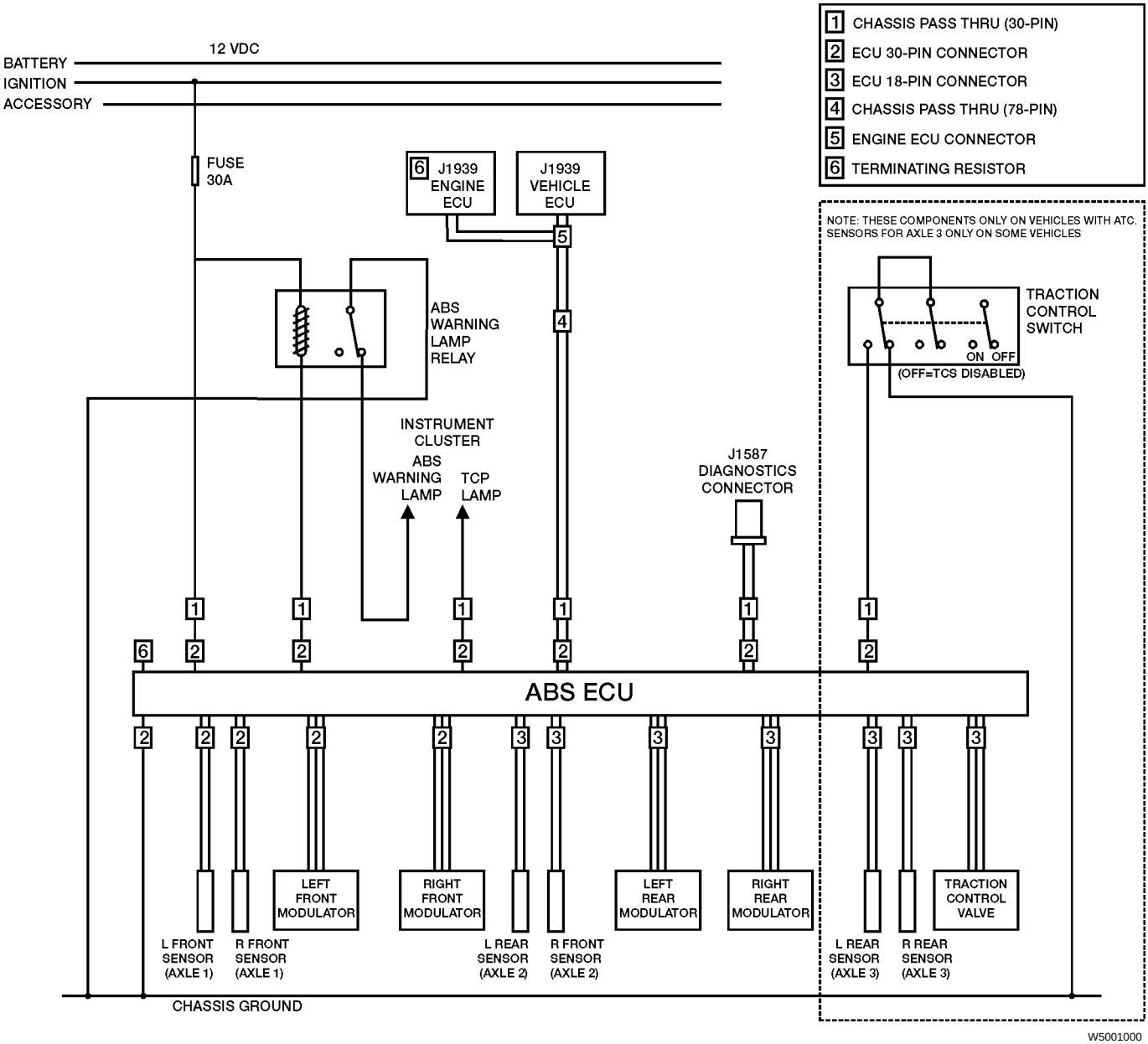
3 Using a portable power supply, energize the valve and verify that a full brake application occurs. Remove the power and verify that the brakes fully release.

4 If the coil resistance is incorrect or the brakes do not apply and release properly, the valve should be replaced.

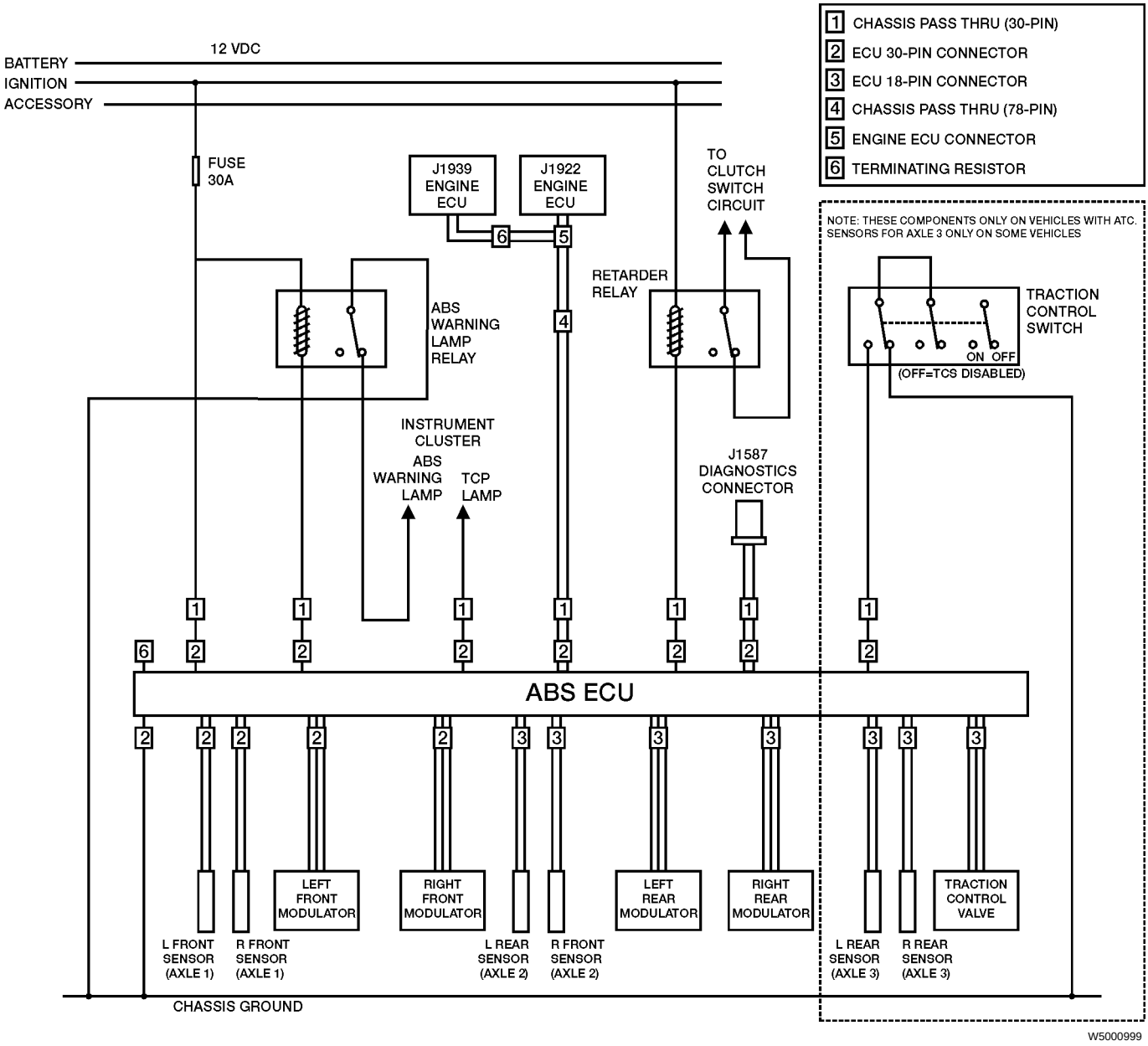
5 Reconnect the electrical connector to the valve.

System Diagrams

ABS System Diagram, VOLVO Engine



ABS System Diagram, Vendor Engine



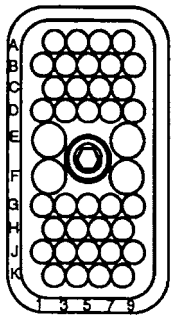
Chassis and ECU Connectors

CONNECTOR PIN SCHEDULE FOR ABS RELATED ECU AND CHASSIS CONNECTORS

CHASSIS PASS THRU 30–PIN CONNECTOR

CAVITY	FUNCTION
D1	TRACTION CONTROL ENABLE SIGNAL
D3	RETARDER RELAY SIGNAL
D5	TCS LAMP SIGNAL
D7	ABS LAMP RELAY SIGNAL
E1	12 VOLT SUPPLY
K2	SAE J1587/1708 DATA LINK (+)
K4	SAE J1587/1708 DATA LINK (-)
K6	TRACTION CONTROL SAE J1922 (=)
K8	TRACTION CONTROL SAE J1922 (-)

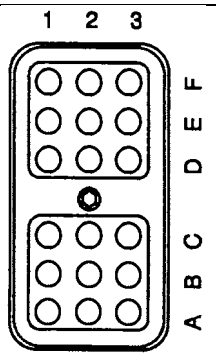
Note: Connector is shown from insertion-side.



ABS ECU 18–PIN CONNECTOR

CAVITY	FUNCTION
A1	RIGHT REAR MODULATOR VALVE COMMON
B1	LEFT REAR MODULATOR VALVE HOLD
C1	RIGHT REAR MODULATOR VALVE EXHAUST
D1	LEFT REAR MODULATOR VALVE EXHAUST
D2	TRACTION CONTROL SOLENOID SUPPLY
D3	TRACTION CONTROL SOLENOID GROUND
E1	LEFT REAR MODULATOR VALVE HOLD
E2	RIGHT REAR SENSOR SIGNAL
E3	RIGHT REAR SENSOR RETURN
F1	LEFT REAR MODULATOR VALVE COMMON
F2	LEFT REAR SENSOR SIGNAL
F3	LEFT REAR SENSOR RETURN

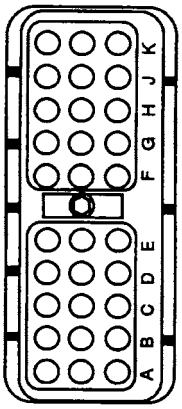
Note: Connector is shown from insertion-side.



ABS ECU 30–PIN CONNECTOR

CAVITY	FUNCTION
A1	ECU GROUND
A2	ECU GROUND
A3	ECU GROUND
B1	ECU 12 VOLT SUPPLY
B2	TRACTION CONTROL SAE J1922 DATA LINK (+)
B3	TRACTION CONTROL SAE J1922 DATA LINK (-)
C1	RIGHT FRONT MODULATOR VALVE COMMON
C2	TCS LAMP GROUND
C3	J1939
D1	RIGHT FRT MODULATOR HOLD
D2	J1939
D3	J1939
E1	RIGHT FRT MODULATOR EXHAUST
E3	WARNING LAMP
F1	LEFT FRT MODULATOR VALVE EXHAUST
F2	TRACTION CONTROL ENABLE SWITCH
G1	LEFT FRONT MODULATOR VALVE HOLD
G2	SAE J1587/1708 DIAGNOSTIC DATA LINK (+)
G3	SAE J1587/1708 DIAGNOSTIC DATA LINK (-)
H1	LEFT FRT MODULATOR VALVE COMMON
H2	RIGHT FRT SENSOR SIGNAL
H3	RIGHT FRT SENSOR RETURN
J1	LEFT FRT SENSOR SIGNAL
J2	LEFT FRT SENSOR RETURN
K1	EGINE BRAKE/RETARDER DISABLE
K2	ECU 12 VOLT SUPPLY
K3	ECU 12 VOLT SUPPLY

Note: Connector is shown from insertion-side.

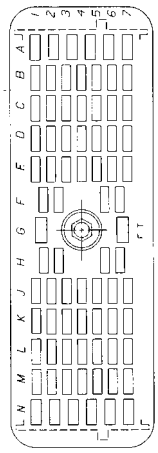


Vendor engine ECU connectors

CONNECTOR PIN SCHEDULE FOR ENGINE ECU FOR VENDOR ENGINES

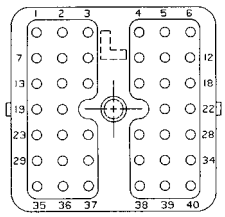
VOLVO ENGINE ECU (78–PIN CHASSIS PASS THRU) CONNECTOR

CAVITY	FUNCTION	CIRCUIT
M5	J1922	
M6	J1922	
H4	J1939 (HIGH)	406
H6	J1939 (Shielded)	408
H8	J1939 (LOW)	407



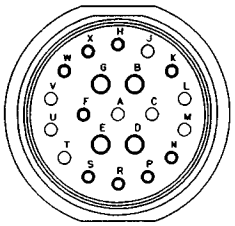
CATERPILLAR ENGINE ECU CONNECTOR

CAVITY	FUNCTION
3	J1922
9	J1922



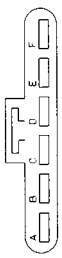
CUMMINS ENGINE ECU CONNECTOR

CAVITY	FUNCTION
N	J1922
P	J1922



DDEC ENGINE ECU CONNECTOR

CAVITY	FUNCTION
A	J1922
B	J1922



Feedback

One of our objectives is that workshop personnel should have access to correct and appropriate service manuals where it concerns fault tracing, repairs and maintenance of Volvo trucks.
In order to maintain the high standards of our literature, your opinions and experience when using this manual would be greatly appreciated.
If you have any comments or suggestions, make a copy of this page, write down your comments and send them to us, either via telefax or mailing directly to the address listed below.

To

Volvo Trucks North America, Inc.

Dept. 516 Service Publications

7825 National Service Road

P.O. Box 26115

Greensboro, NC 27402-6115

USA

Fax (336) 393-3170

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Comments/proposals

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Volvo Trucks North America, Inc.
P.O. Box 26115, Greensboro, NC 27402-6115
Volvo Trucks Canada, Ltd.
6490 Vipond Drive, Mississauga, Ontario L5T 1W8
http://www.volvotrucks.volvo.com

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