

# **ELECTRONICALLY CONTROLLED AIR SUSPENSION (ECAS) FOR BUSES**

**MAINTENANCE MANUAL**

**WABCO**

## Before You Begin

This manual describes the correct service and repair procedures for the WABCO Electronically Controlled Air Suspension (ECAS) for buses.

Before you begin procedures:

1. Read and understand all instructions and procedures before servicing components.
2. Read and observe all Caution and Warning safety alerts that precede instructions or procedures you will perform. These alerts help to avoid damage to components, serious personal injury, or both.
3. Follow your company's maintenance and service, installation, and diagnostics guidelines.
4. Use special tools when required to help avoid serious personal injury and damage to components.

## How to Obtain Additional Maintenance and Service Information

Visit Literature on Demand at [meritor.com](http://meritor.com). WABCO publications are also available on our website: [wabco-na.com](http://wabco-na.com).

## Safety Alerts, Torque Symbol and Notes

 <b>WARNING</b>	A Warning alerts you to an instruction or procedure that you must follow exactly to avoid serious personal injury.
 <b>CAUTION</b>	A Caution alerts you to an instruction or procedure that you must follow exactly to avoid damage to components.
	A torque symbol alerts you to tighten fasteners to a specified torque value.
<b>NOTE</b>	A Note provides information or suggestions that help you correctly service a component.

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## Contents

This manual contains service information for the WABCO Electronically Controlled Air Suspension (ECAS) for buses with full air suspensions.

The ECAS system operates in conjunction with the WABCO Anti-Lock Braking System (ABS). ECAS cannot function without ABS. ECAS uses information from the ABS to determine vehicle speed and adjust ECAS operation accordingly.

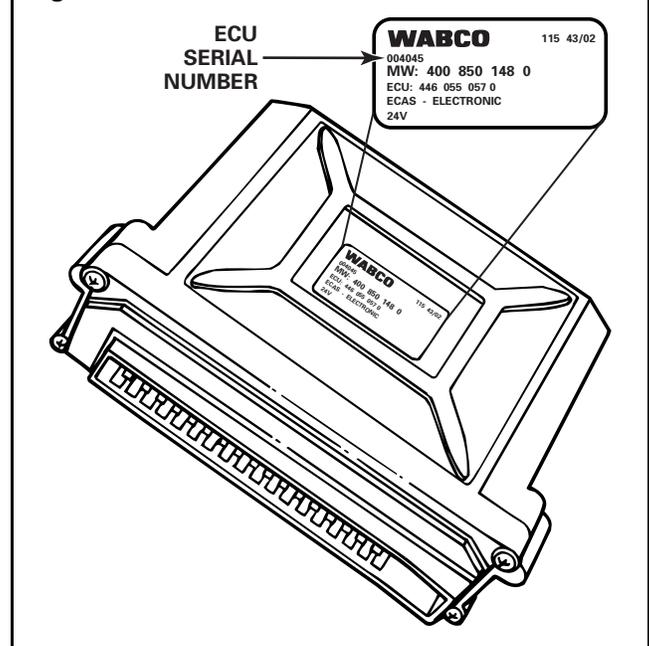
## Overview

### ECAS System Features and Benefits

The WABCO ECAS is an electronically controlled air suspension system designed to enhance the function of the vehicle's air suspension. Some of the features provided by ECAS include:

- **Automatic Level Control** — ECAS continually monitors the vehicle's height and uses electronics to increase or decrease the air in the suspension air bags whenever a deviation in height occurs. ECAS will maintain the correct vehicle height regardless of the number of passengers boarding or unloading.
- **Manual Level Adjustment** — If a driver wishes to change to a vehicle level different than the normal level maintained by ECAS (for travelling over speed bumps or under low structures, etc.), a manual switch is used to raise or lower the bus.
- **Front Kneeling** — ECAS performs a kneeling function and maintains the vehicle's optimum kneeling level. This function can be especially helpful to mobility-impaired passengers.
- **Limited Height** — This feature prevents the driver from accidentally over-inflating the air bags when adjusting the vehicle height. Over-inflation can damage the suspension air bags and shock absorbers.
- **Wheel Chair Unstowed** — This feature inhibits all suspension motion while the wheel chair lift mechanism is in use. This feature is available on systems with ECAS Electronic Control Units (ECUs) that have serial numbers of 4000 and higher. **Figure 1.1.**

Figure 1.1



The incorporation of WABCO ECAS into the air suspension system provides many benefits, including:

- **Simplified and Reduced Plumbing** — In combination with operating switches, ECAS can control safety interlocks which, in conventional air suspension systems, normally require a large number of additional valves.
- **Reduction of Air Consumption** — ECAS reduces air consumption while the vehicle is in motion.
- **High Speed Control Process** — Since a single valve controls the air suspension, ECAS provides a quick response to kneeling commands as well as load and height changes.
- **Reliability and Easy Maintenance** — The system contains a self-monitoring feature to detect possible faults and notify the driver through a warning lamp on the dash panel. Maintenance is simplified by a reduction in the number of air lines.
- **Parameter Programming** — ECAS parameters are set by the vehicle manufacturer. If you have any questions about these parameters, contact the vehicle manufacturer.

## Operation

### ECAS System

#### Automatic Level Control

ECAS maintains an accurate leveling of chassis height through the use of sensors, an electronic control unit (ECU) and a solenoid valve. The ECU uses sensor information to determine vehicle chassis height. If the height needs to be adjusted, the ECU controls pressure within the suspension air bags by actuating a solenoid valve. In this way, ECAS is able to quickly adjust chassis height to a predetermined normal level. This automatic function can occur while the vehicle is in motion or parked. **Figure 1.2.**

#### Inclination Level Control

The solenoid valve can adjust pressure in all of the air bags or in individual air bags. This allows ECAS to compensate for inclinations caused by unbalanced loading in the front, rear, left side or right side of the bus. In this situation, pressure is increased at the air bag(s) on the more heavily loaded side to achieve normal level. Since the bus is only equipped with one level sensor on the front axle, left to right leveling is controlled at the rear axle.

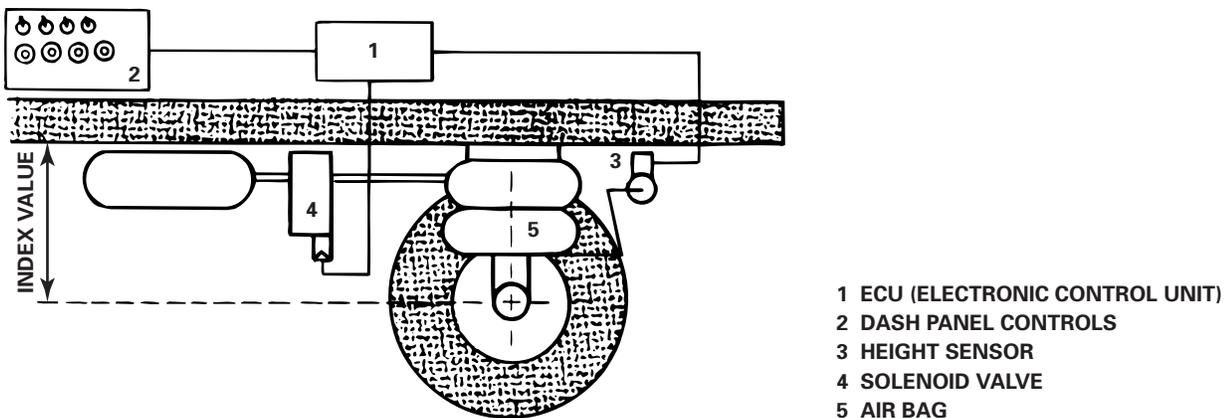
#### Manual Level Control

Dash panel switches allow the driver to raise and lower the suspension to preset high ride and low ride levels. This feature provides the bus with extra clearance to cross railroad tracks and speed bumps or to get under low structures. The driver can also return the bus to normal ride height with a dash panel switch.

#### Kneeling

The driver can activate the kneeling feature through a dash panel switch. Activating the KNEELING switch instructs the ECU to signal the solenoid valve to exhaust air from the front air suspension while maintaining the rear suspension at normal height. This lowers the bus approximately 5 inches (127 mm) at the entry door step. The kneeling feature can only be activated when the vehicle is in neutral, the parking brake is applied and the door is closed. A change in any of these conditions while the bus is changing to the kneeling level will immediately interrupt the level change. The driver can also interrupt the kneeling function through a dash-mounted STOP switch. The bus will automatically return to normal ride height from the kneeling position if the parking brake is released or the transmission is shifted out of neutral while the door is closed.

**Figure 1.2**



## ECAS Height Change Requirements

Several features have been built into the ECAS system to help ensure correct level changes. The status of the bus door, parking brake, transmission and bus height are all considered by the ECU before a level change is initiated. **Table A** displays how these features apply to each ECAS function. The last column in the table lists the switches used to initiate manual ECAS level changes.

**Table A: ECAS Height Change Requirements**

ECAS Function	Doors	Parking Brake	Transmission	Speed	Kneeling	Height	Switches
Normal/ Recover	Closed	No Effect	No Effect	No Effect	No Effect	No Effect	NORMAL/ RECOVER
Lifting	Closed	Released	Not Neutral	Less than or Equal to $V_{LIMIT}$ (Param. 17)	Not Active	No Effect	HIGH RIDE
Lowering	Closed	Released	Not Neutral	Less than or Equal to $V_{LIMIT}$ (Param. 17)	Not Active	No Effect	LOW RIDE
Kneeling	Closed	Applied	Neutral	Less than or Equal to 5 mph (no speed signal fault)	Not Interrupted	Greater than or Equal to Normal	KNEELING
Shipping Level	Closed	Applied	Neutral	Less than or Equal to $V_{LIMIT}$ (Param. 17)	Not Active	No Effect	SHIPPING LEVEL
Disable All Suspension Movement*	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect	WHEEL CHAIR STOWED SIGNAL FROM LIFT CONTROLLER

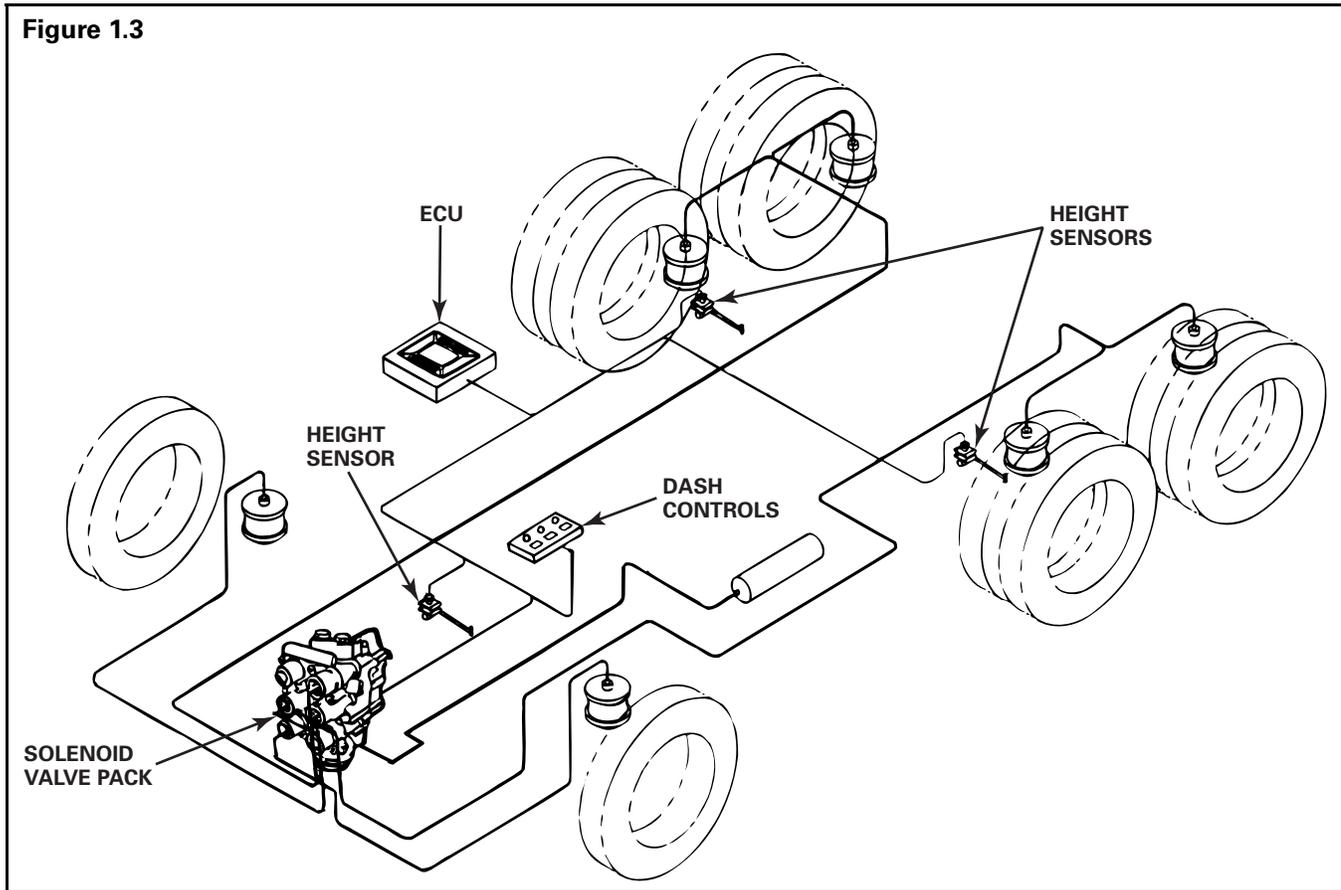
V = Velocity

\* Wheel chair lift inhibit feature on systems with ECAS ECUs with serial numbers of 4000 and higher.

## Components

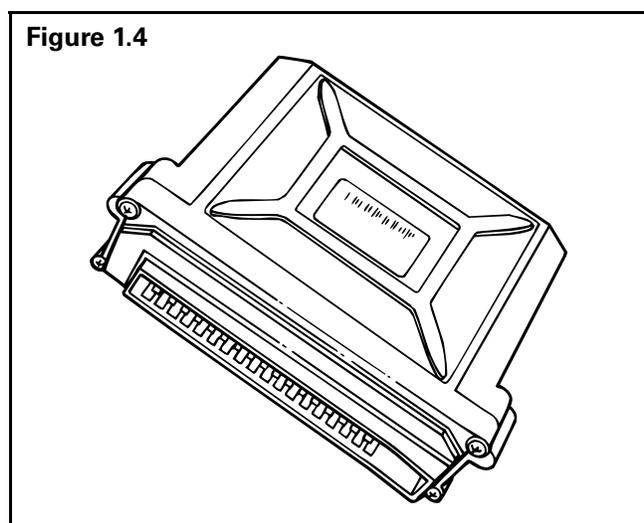
### Major Components

Figure 1.3 illustrates the major components of the ECAS system.



### Electronic Control Unit (ECU)

The ECU, **Figure 1.4**, contains a microprocessor, memory, input conditioners and output drivers. A 35-pin connector links the ECU with other ECAS components, various instrument panel ECAS switches and lamps, external ECAS alarm and lamp, the vehicle's communication datalink, the ABS/ATC ECU and the vehicle's stop light switch, neutral safety switch, parking brake switch, wheel chair lift controller and door position sensor.

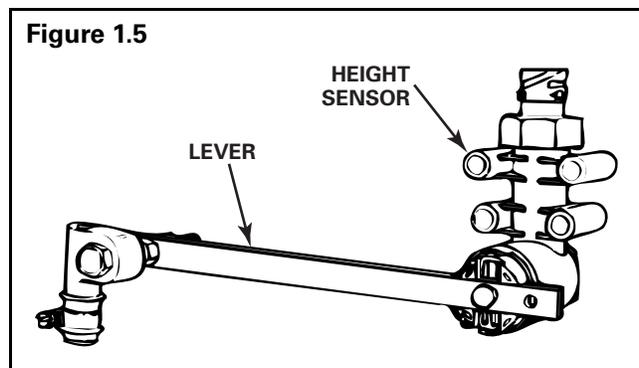


The ECU is responsible for:

- Constantly monitoring incoming signals
- Comparing the signal to nominal values stored in memory
- Determining the required controlling reaction if the actual level differs from the nominal level
- Actuating the solenoid valve block to adjust the level
- Managing and storing index levels (normal levels, preset limits, etc.)
- Monitoring the function of all system components and storing information about any detected errors
- Receiving data from the dash panel controls, sensors and switches
- Exchanging data with the diagnostic controller or PC diagnostic program

### Height Sensor

Three height sensors mounted on the chassis provide the ECU with chassis height signals. **Figure 1.5.** The sensor housing contains an inductive coil in which an armature is moved up and down. The armature is connected to a lever which is attached to the axle by a linkage rod. When the distance between the chassis and the axle changes, the lever turns, causing the armature to move into or out of the coil within the sensor. This modifies the signal produced by the sensor.

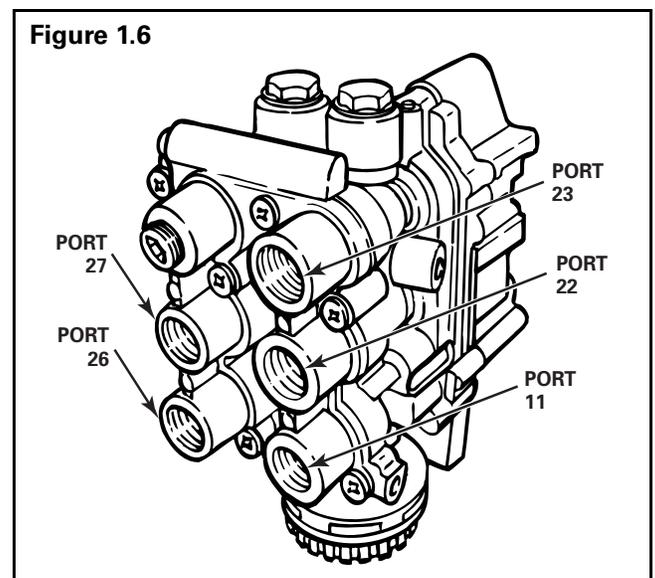


The height sensors are connected to the ECU at the following pins:

- Front axle height sensor — ECU pin 26
- Rear axle height sensor, left — ECU pin 25
- Rear axle height sensor, right — ECU pin 8

### Solenoid Valve Block

Special solenoid valve blocks have been developed for the ECAS system. **Figure 1.6.** Several solenoid valves are combined into one compact block. This saves space and reduces installation time. The solenoid valves are actuated by the ECU. Voltage from the ECU to the solenoid valves controls the air volume within the air bags, either increasing or reducing the volume as necessary. If not activated, the valves are closed and maintain the air bags' volume. The solenoid valve block is usually mounted on the chassis. Two four-pin connectors link it to the ECU. It includes air ports to supply air or vent air from the air bags through the air lines.



Solenoid valve block air line connections:

- Right front air bag to port 27
- Left front air bag to port 26
- Right rear air bag to port 22
- Left rear air bag to port 23

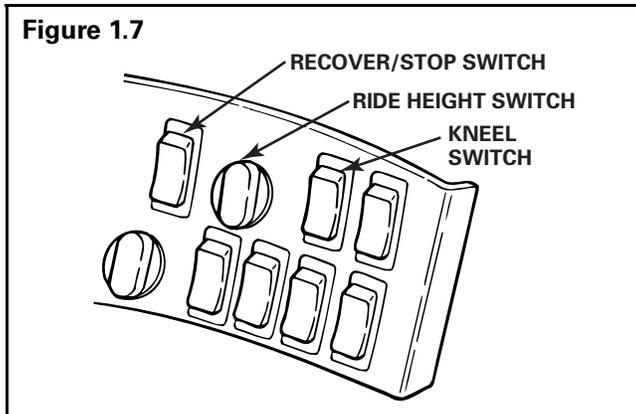
The solenoid valve block is connected to the ECU at the following pins:

- Solenoid valve rear axle, right — ECU pin 31
- Solenoid valve rear axle, left — ECU pin 13
- Solenoid valve front axle — ECU pin 30
- Solenoid valve 3/2 (raise/lower) — ECU pin 15

## Dash Panel Lamps

The ECU will activate all of the following lamps for one to two seconds each time the ignition is switched on. If the lamp does not illuminate, the bulb or circuit is faulty.

**Figure 1.7** illustrates a typical ECAS dash control system. Actual dash layouts will vary depending upon the bus manufacturer.



## RIDE FAULT Indicator Lamp

ECAS system failures are indicated by the RIDE FAULT indicator lamp mounted on the dash panel. The ECU illuminates the lamp if a minor fault is detected or system voltage is low (between 7.5 V and 18 V). If a major fault is detected by the ECU, the lamp will blink. This lamp is also used to display diagnostic blink codes. The RIDE FAULT lamp is connected to ECU pin 33.

## LOW RIDE Lamp

When the bus is at low ride height on both axles, the LOW RIDE lamp is illuminated. If the bus is only at low ride height on one axle, the lamp flashes. The LOW RIDE lamp is connected to ECU pin 14.

## HIGH RIDE Lamp

When the bus is at high ride height on both axles, the HIGH RIDE lamp is illuminated. If the bus is only at high ride height on one axle, the lamp flashes. The HIGH RIDE lamp is connected to ECU pin 35.

## KNEELING Lamp

When the bus is in the kneeling position, the KNEELING lamp is illuminated. If the bus is in transition to or from kneeling, the lamp flashes. The KNEELING lamp is connected to ECU pin 18.

## Dash Panel Switches

### LOW or HIGH RIDE HEIGHT Switch

Low or high ride can be initiated by holding the RIDE HEIGHT switch in the low or high ride position. The parking brake must be released and the transmission **cannot be** in neutral for the level change to take effect. The lifting or lowering process is maintained only while the RIDE HEIGHT switch is held in the low or high ride position. Releasing the switch interrupts the lifting or lowering process. If the process is interrupted before the maximum high or low ride is attained, the process can be continued by reengaging the switch. The RIDE HEIGHT switch is connected to ECU pins 16 and 19.

### NORMAL or RECOVER Switch

The bus is returned to the normal ride height by pressing the NORMAL/RECOVER switch. The recover process continues until normal height is reached even if the switch is released. The RECOVER switch is connected to ECU pins 16 and 19.

### STOP Switch

If the STOP switch is pressed, any height change function is suspended. The bus remains at the stopped height until some action instructs the ECU to change height. The STOP switch is connected to ECU pins 19 and 23.

### Manual KNEELING Switch

Kneeling can be initiated by pressing and holding the KNEELING switch. The parking brake must be applied, the transmission in neutral and the door closed for kneeling to occur. The kneeling process is maintained only while the KNEELING switch is pressed. Releasing the switch interrupts the kneeling lowering process. If the kneeling process is interrupted, the suspension must recover to normal ride height before kneeling can be attempted again. The KNEELING switch is connected to ECU pin 23.

### Automatic KNEELING Switch (Optional)

This switch provides the same function as the KNEELING switch, except the switch can be released after it is pressed and the kneeling process will continue until completion or it is interrupted. The Automatic KNEELING switch is connected to ECU pin 21.

**SHIPPING LEVEL Switch (Optional)**

The bus chassis can be lowered to the bump stops for non-driving transportation purposes (e.g., shipping the bus over water) by pressing the SHIPPING LEVEL switch. The parking brake must be applied, the transmission in neutral, the door closed and the bus must not be kneeling in order to lower the bus to the shipping level. The shipping level lowering process continues even if the switch is released. The SHIPPING LEVEL switch is connected to ECU pin 17.

**Miscellaneous Components and Functions****Audible Alarm (Optional)**

An ECAS alarm is mounted in the dash panel. This alarm will sound during any lifting or lowering process (except automatic leveling) and whenever the vehicle exceeds the programmed speed limit for non-normal level driving if the actual level is not the normal level. The alarm is connected to ECU pin 11.

**Brake Application Sensing**

The bus brake light switch provides the ECU with brake pedal position information. During a brake application each automatic level correction is generally interrupted or not started. The brake light switch is connected to ECU pin 7.

**Door Position Sensing**

A sensor in the door assembly signals the ECU when the door is open. An open door prevents any ECAS function. Opening the door will suspend any ECAS function. The door sensor is connected to ECU pin 5.

**Exterior Kneeling Indicators (Optional)**

An exterior ECAS alarm and indicator lamp may be installed on the bus. The ECU will activate the external kneeling indicators during the lowering or recovering portion of the kneeling cycle. The external alarm and indicator lamp are connected to ECU pin 12.

**External KNEELING Switch (Optional)**

Kneeling can be initiated from outside of the bus by pressing and holding the External KNEELING switch. The switch is usually located near the bus door. The switch functions in the same manner as the dash-mounted KNEELING switch. The External KNEELING switch is connected to ECU pin 23.

**External RECOVER Switch (Optional)**

The bus can be returned to normal ride height by pressing and holding the External RECOVER switch. The switch is usually located near the bus door. The switch functions in the same manner as the dash-mounted RECOVER switch. The External RECOVER switch is connected to ECU pins 19 and 16.

**Parking Brake Status**

The bus parking brake switch provides the ECU with the status of the parking brake. If the parking brake is applied, lifting and lowering using the RIDE HEIGHT switch is disabled. If the parking brake is not applied, the kneeling function is disabled. If the parking brake is released during the kneeling process, the bus will return to normal height. The parking brake switch is connected to ECU pin 10.

**Transmission in Neutral Sensing**

The bus neutral safety switch provides the ECU with a signal when the transmission is in neutral. If the transmission is in neutral, lifting and lowering using the RIDE HEIGHT switch is disabled. If the transmission is not in neutral, the kneeling function is disabled. If the transmission is removed from neutral during the kneeling process, the bus will return to normal ride height. The neutral position switch is connected to ECU pin 28.

**Wheel Chair Lift Inhibit (Optional)**

The ECU will send a wheel chair lift inhibit signal to the wheel chair lift controller if the actual level of the rear axle is higher than a programmed threshold height. The wheel chair lift inhibit circuit is connected to ECU pin 32. Refer to the vehicle manufacturer's manual for additional information.

**Wheel Chair Lift Unstowed (For ECUs with serial numbers of 4000 and higher)**

The ECU receives this signal from the wheel chair lift controller. If +24 V is applied to ECU pin 24, all suspension movement is interrupted or prevented.

**Vehicle Speed**

The ECAS ECU receives vehicle speed information from the ABS/ATC ECU via the SAE J1587 datalink. Vehicle speed affects low ride, high ride and kneeling functions. The SAE J1587 datalink is connected to ECU pins 2 and 4.



### Faults



#### WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

All personnel must be clear of the vehicle before you begin to troubleshoot ECAS. Serious personal injury can result when the vehicle chassis moves up and down.

### ABS Faults

Before performing any ECAS diagnostics, make sure there are no ABS faults. Because of the interaction between the ABS and ECAS, a fault in the ABS may restrict the functionality of the ECAS system.

### ECAS Faults

The ECU monitors the ECAS system for faulty operation and component failure. Detected component or system failures are stored in the ECU's memory and can be retrieved using the ECAS blink code feature, WABCO Diagnostic Controller or a personal computer with WABCO ECAS diagnostic software. Faults are prioritized into three categories:

- Major Fault Category 1
- Major Fault Category 2
- Minor Fault

The ECU's response to a fault varies with each category.

#### Major Fault Category 1

If the ECU detects a category 1 major fault, it will disable the ECAS system, store the fault in memory and cause the RIDE FAULT indicator lamp to flash.

A category 1 major fault may be caused by:

- Loss of power (Test for correct voltage before replacing the ECU.)
- Defective ECU

If a category 1 major fault is indicated, replace the ECU. The ECAS system can then be reactivated by switching the ignition off and on.

#### Major Fault Category 2

If the ECU detects a category 2 major fault, it will disable the automatic leveling functions, store the fault in memory and cause the RIDE FAULT indicator lamp to flash. Manual ride height adjustment may be possible depending on the type of fault. After the fault has been repaired, the ECAS system may reactivate automatically or can be reactivated by switching the ignition off and on.

The following are category 2 major faults:

- Programmed parameters are incorrect or have not yet been stored
- Calibration faults of the height sensors
- Failure of all height sensors on one axle either by short circuit or open circuit
- Electrical defect of solenoid valves either by short circuit or open circuit

If all category 2 major faults have been corrected, but cannot be cleared from memory, replace the ECU.

#### Minor Fault

If the ECU detects a minor fault, it will store the fault in memory and illuminate the RIDE FAULT indicator lamp (continuously on, not flashing). Normal operation of the ECAS system may still be possible, with different limitations depending on the component which has failed. After the fault has been repaired, the ECAS system will operate normally.

The following are minor faults:

- Failure of one (of two) height sensors on rear axle either by short circuit or open circuit. The ECU will use the height information from the functioning second sensor and apply this value to both sides of the axle. ECAS operation continues.
- Speed signal monitoring failed. The ECAS system continues to operate with the following restrictions:
  - Kneeling is disabled
  - Speed-dependent dash alarm is not active
  - Speed-dependent adjustment of normal level is not active

**NOTE:** As soon as the speed signal is correct, ECAS returns to normal operation.

- Failure of exterior alarm
- Failure of dash alarm
- Failure of wheel chair lift inhibit output

## Ride Fault Indicator Lamp

The RIDE FAULT indicator lamp, mounted on the dash panel, indicates when ECAS system faults are stored in memory. The ECU illuminates the lamp if a minor fault is detected or system voltage is low (between 7.5 V and 18 V). If a major fault is detected by the ECU, the lamp will blink. This lamp is also used to display diagnostic blink codes.

When the ignition key is switched on, the lamp will come on for two seconds and then go out if no faults are present. If the lamp does not come on at start-up, the lamp bulb or circuit is faulty.

## Retrieving Faults

Faults can be retrieved from the ECU's memory in three ways:

- Activating the blink code system
- Connecting the WABCO Diagnostic Controller to the vehicle's SAE 1587 diagnostic plug
- Connecting a personal computer with WABCO ECAS diagnostic software to the vehicle's SAE 1587 diagnostic plug with the appropriate datalink converter

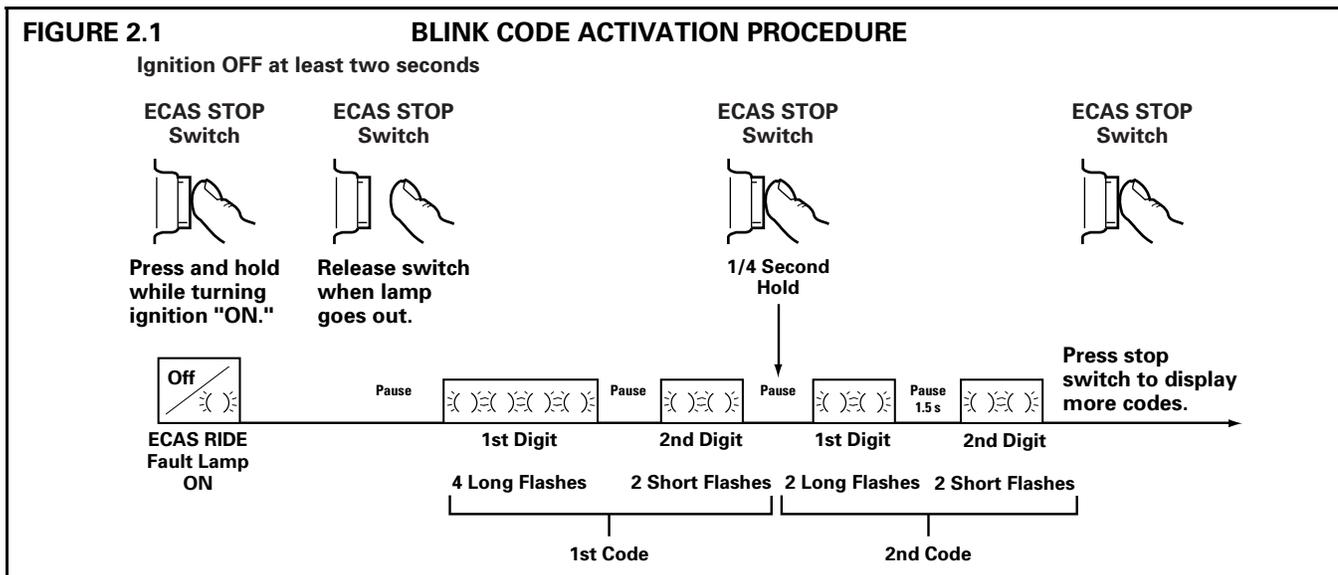
## Blink Codes

The blink code feature allows you to identify ECAS fault codes stored in the ECU's memory when a diagnostic tool is not available. The ECAS system displays the faults by blinking the RIDE FAULT lamp on the dash panel. All blink codes are comprised of two digits.

## Blink Code Activation Procedure (Figure 2.1)

1. Turn the vehicle ignition off for at least two seconds.
2. Press and hold the ECAS STOP switch on the dash panel.
3. While pressing the STOP switch, turn the ignition to the ON position. The ECAS RIDE FAULT lamp may blink briefly, but will go out.  
  
If the lamp does not go out, there may be a problem in the lamp circuit (shorted to ground) or in the ECU. If there is a problem in the ECU, contact WABCO North America Customer Care at 855-228-3203.
4. When the lamp goes out, release the STOP switch.
5. The RIDE FAULT lamp will flash a series of long blinks, followed by a pause, and then will flash a series of short blinks. **Figure 2.1.** Record the number of long and short blinks. The number of long blinks is the code's first digit and the number of short blinks is the second digit. All uncorrected faults can be displayed.
6. Press the STOP switch again for at least 1/4 second to read the next blink code. Repeat until no additional codes are displayed.
7. Use **Table B** to identify the component(s) that requires service.

**The blink code output will end if the STOP switch is not pressed within one minute of the last displayed code.**



**Table B: ECAS Blink Code Identification**

# Long Flashes	# Short Flashes	Type of Fault
0	1	Parameter fault — Contact the vehicle manufacturer
0	2	Distance sensor calibration fault — Re-calibrate
0	3	ECU program fault — Replace ECU
0	4	ECU data fault — Replace ECU
0	5	ECU distance sensor electrical circuit fault — Replace ECU
0	6	ECU RAM fault — Replace ECU
0	9	ECU valve relay fault — Replace ECU
1	0	Distance sensor, rear axle right — Open circuit/short circuit to battery
1	1	Distance sensor, rear axle left — Open circuit/short circuit to battery
1	2	Distance sensor, front axle — Open circuit/short circuit to battery
2	0	Distance sensor, rear axle right — Short circuit to ground
2	1	Distance sensor, rear axle left — Short circuit to ground
2	2	Distance sensor, front axle — Short circuit to ground
3	0	Raise/lower solenoid valve — Open circuit/short circuit to battery
3	1	Raise/lower solenoid valve, rear axle left — Open circuit/short circuit to battery
3	2	Raise/lower solenoid valve, rear axle right — Open circuit/short circuit to battery
3	3	Output exterior sounder — Open circuit/short circuit to battery
3	4	Raise/lower solenoid valve, front axle — Open circuit/short circuit to battery
3	5	Output auxiliary tank control — Open circuit/short circuit to battery
3	6	Output dash sounder — Open circuit/short circuit to battery
3	8	Output wheel chair lift inhibit — Open circuit/short circuit to battery
4	0	Raise/lower solenoid valve — Open circuit/short circuit to ground
4	1	Raise/lower solenoid valve, rear axle left — Open circuit/short circuit to ground
4	2	Raise/lower solenoid valve, rear axle right — Open circuit/short circuit to ground
4	3	Output exterior sounder — Open circuit/short circuit to ground
4	4	Raise/lower solenoid valve, front axle — Open circuit/short circuit to ground
4	5	Output auxiliary tank control — Short circuit to ground
4	6	Output dash sounder — Short circuit to ground
4	8	Output wheel chair lift inhibit — Short circuit to ground
8	0	ECU data fault — Replace ECU
8	1	Speed signal fault — Check SAE J1587 connection

### Erasing Stored Faults

1. Press the STOP switch for at least five seconds after the ignition-on bulb check is finished. All stored faults will be cleared.
2. Any faults which were not corrected will be detected and stored again and may be read using the blink code activation procedure.

- Access ECAS system faults stored in the ECU
- Perform functionality tests on ECAS components
- Perform multimeter style voltage and resistance checks on system wiring and components
- View control equipment data stored in the ECU
- Calibrate the ECAS height sensors and ECU

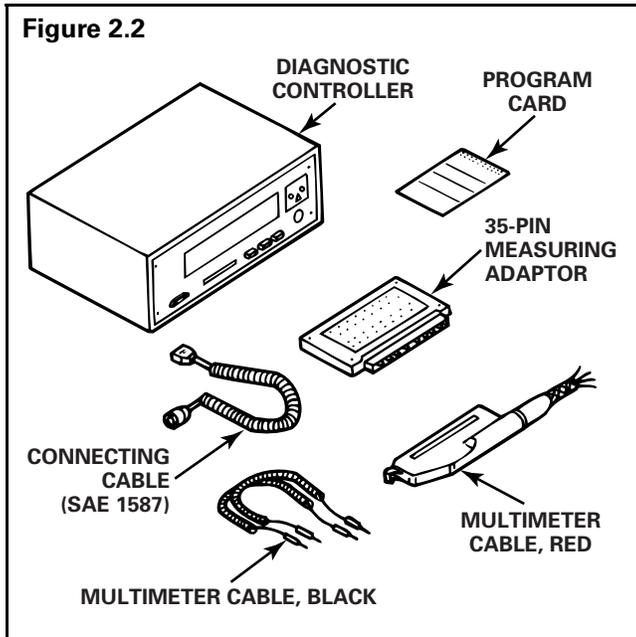
### WABCO Diagnostic Controller

The WABCO diagnostic controller is an electronic diagnostic tool that is capable of communicating with the ECAS ECU. **Figure 2.2.** You can use the controller to:

## Section 2 Troubleshooting and Testing

**WABCO**

**NOTE:** This manual provides a brief overview of the capabilities and operation of the diagnostic controller. For detailed instructions on using the controller, refer to the operating instructions included with the diagnostic controller.



### Connecting the Diagnostic Controller

The diagnostic controller is connected to the vehicle through an SAE 1587 diagnostic plug that is wired to the ECU. Inserting the appropriate program card for the vehicle's ECAS application into the diagnostic controller enables the controller to retrieve all relevant data from the ECU and perform a variety of diagnostic functions.

### Displaying Stored Faults

If faults are present in the ECAS system, they are displayed in descriptive text on the controller screen. Also shown are the number of times the fault has occurred and whether the fault is currently present. In this way, intermittent faults can be displayed.

In order to locate the exact source of a fault, the diagnostic controller will change to the multimeter mode if necessary. The controller display screen indicates specific tests that should be performed on the ECAS wiring. Connecting an adaptor to the ECU harness allows easy access to the ECAS wiring for these tests.

After successful repair of a fault, an acknowledgment is displayed on the controller screen and the fault is automatically erased from the ECU memory.

### Height Sensor Calibration

This calibration function also allows recalibration of the ECAS system when the ECU is replaced. Refer to the Operating Instructions included with the diagnostic controller for information on calibrating the ECU.

1. Connect the diagnostic controller to the vehicle's SAE 1587 diagnostic plug.
2. Insert the ECAS Bus SAE program card for the vehicle's ECAS application into the diagnostic controller.
3. Select the Diagnosis menu option.
4. From the Diagnosis menu, select the calibration option.
5. From the Calibration menu, select the Calibrate Height Sensor option.
6. Use the control key to raise or lower the vehicle to normal ride level. Check the vehicle specification for normal parameters.
7. Initiate calibration.
8. Use the control key to raise the vehicle to the upper stop level.
9. Initiate calibration. Refer to the vehicle manufacturer's repair instructions for height level information.
10. Use the control key to lower the vehicle to the lower stop level.
11. Initiate calibration.
12. Disconnect the diagnostic controller from the vehicle.

### Component Function Tests

This feature allows specific ECAS system components to be controlled and their functionality tested. Components are actuated by the diagnostic controller. If a fault is detected during the test, it is reported on the display screen.

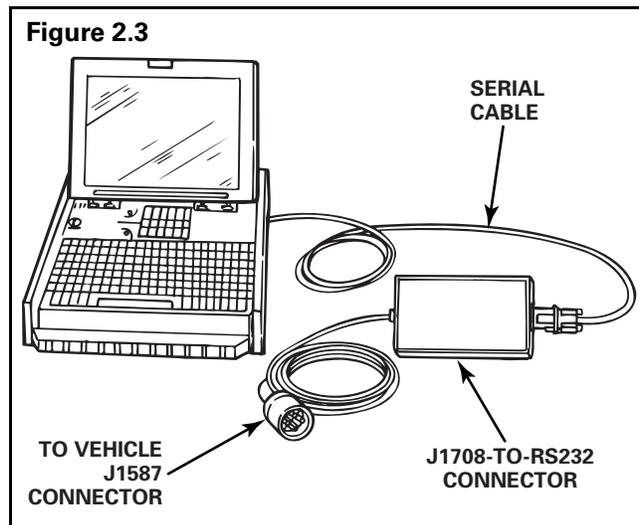
### Personal Computer and Diagnostic Software

The WABCO ECAS Diagnostic software for a personal computer (PC) allows users to retrieve faults from the ECU memory and a variety of other diagnostic tasks, including:

- View current system status
- Illuminate lamps and activate certain outputs
- Raise and lower the suspension
- Calibrate the suspension
- Test raise/lower and position valves
- View programmed vehicle parameters

The PC is connected to the vehicle through the SAE J1587 connector diagnostic plug that is wired to the ECU. A serial cable connects the computer's RS232 to the J1708 level connector which is connected to the vehicle's diagnostic plug.

**Figure 2.3.**



**Figure 2.3**

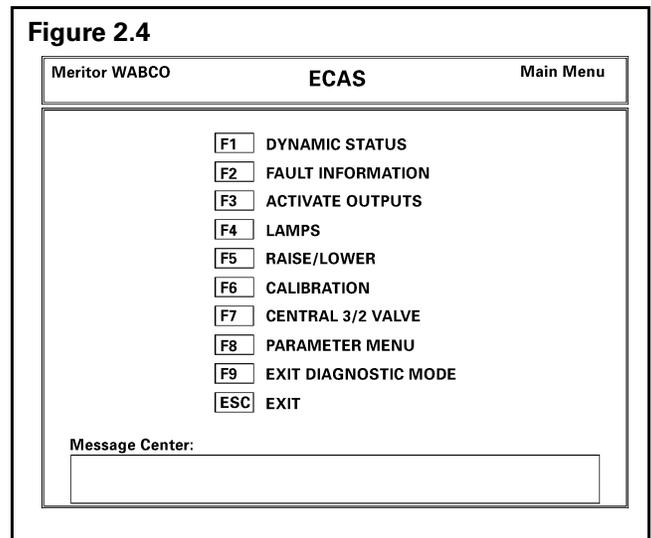
### Starting the Program

1. After connecting the PC to the vehicle, start the PC. The program is DOS-based, so the PC must be placed in DOS mode.
2. During the computer startup sequence, look for the "loading Windows" line. When "loading Windows" appears, press the **F8** key.
3. When the **Microsoft Windows® 95 Startup Menu** appears, select item 6, "Command Prompt Only."
4. At the C: prompt (DOS), type in ECAS and press the **Enter** key to start the program.

**NOTE:** For instructions for creating a shortcut to DOS, see Section 5.

### Diagnostic Software Main Menu

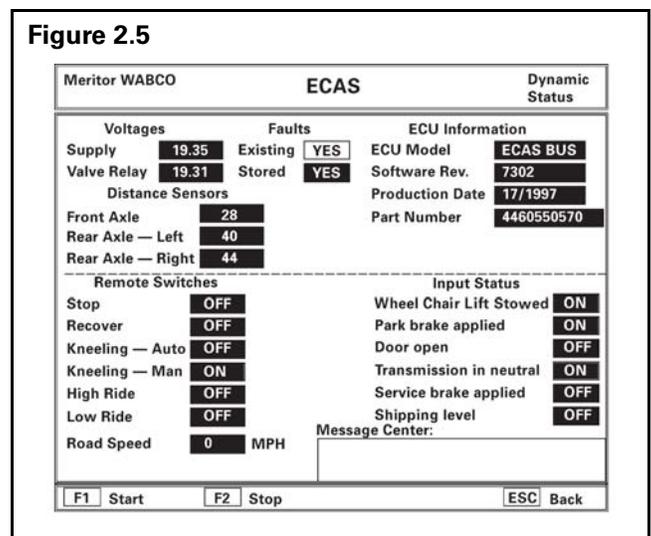
Once connected, run the ECAS Diagnostic program and press any key to display the **Main Menu** screen. **Figure 2.4.**



**Figure 2.4**

### Viewing System Status

From the **Main Menu** screen, press the **F1** key to view the **Dynamic Status** screen. **Figure 2.5.**



**Figure 2.5**

## Section 2 Troubleshooting and Testing

This screen displays:

- System voltages
- Whether or not faults are stored in the ECU's memory
- ECU model information
- Current position of each distance sensor
- Remote switches positions
- Road speed
- Current status of vehicle equipment that affects ECAS operation

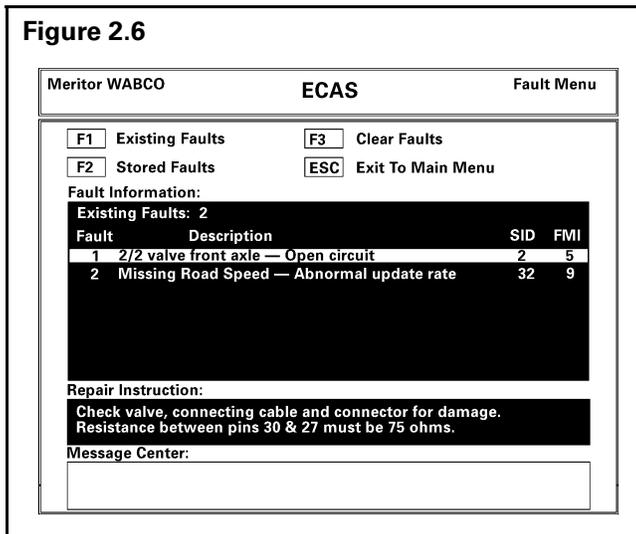
This screen allows you to quickly determine if any faults are present. You can also check whether the input being received by the ECU matches the actual vehicle environment. For example, if the door is closed, but this screen states that the door is open, you know that there is a fault somewhere in the door sensing circuit.

After viewing this screen, press the **Esc** key to return to the **Main Menu** screen.

### Displaying Faults

From the **Main Menu** screen, press the **F2** key to display the **Fault Menu** screen. **Figure 2.6**. From this screen you can access existing faults and stored faults. You can also clear faults from the ECU's memory.

**Figure 2.6**

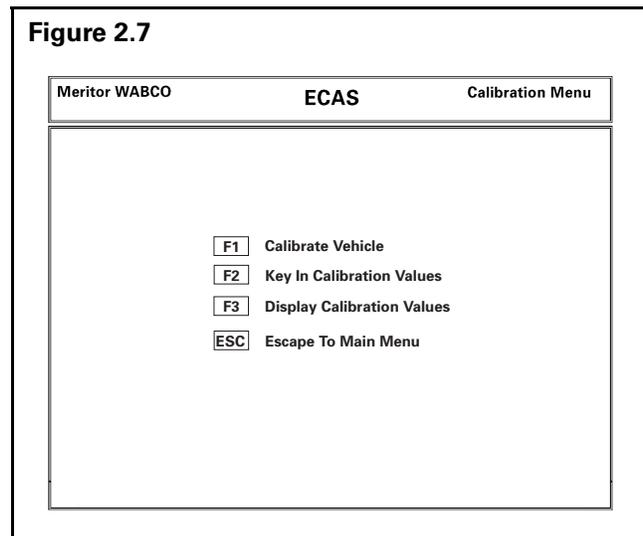


Use the up and down arrow keys to scroll through the list of faults. A repair instruction is displayed for the current highlighted fault. After repairing all of the displayed faults, press the **F3** key to clear the faults from the ECU's memory. Press the **Esc** key to return to the **Main Menu** screen.

### Calibrating the ECAS System

The ECAS system must be calibrated after installing a new height sensor or ECU. From the **Main Menu** screen, press the **F6** key to display the **Calibration Menu** screen. **Figure 2.7**.

**Figure 2.7**



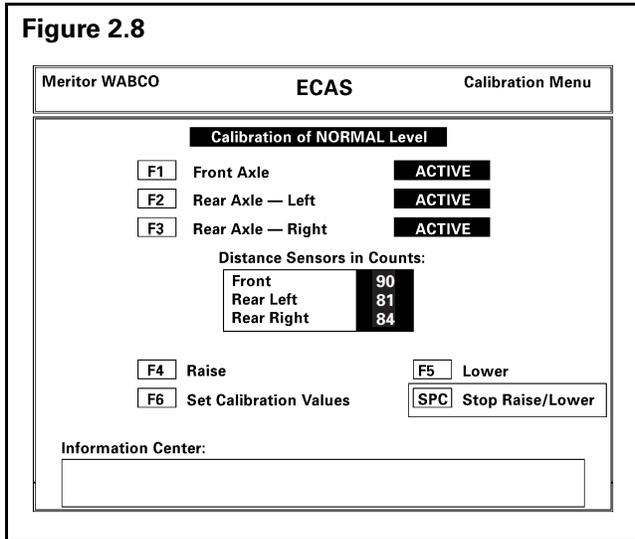
Calibrate the Normal, Upper and Lower levels. **Figure 2.8, Figure 2.9 and Figure 2.10.**

1. Press the F1, F2 or F3 keys to select the air bags to be activated and deselect the air bags that are not being activated.
2. Press the F4 and F5 keys to raise or lower the vehicle to the desired height. Pressing the space bar will stop the raising or lowering action.

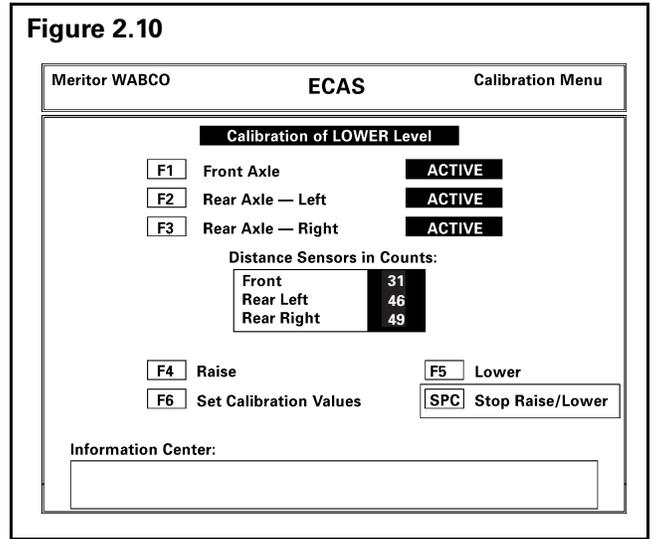
Check the vehicle manufacturer's specifications to determine the parameter range.

3. When the desired level is achieved, press the F6 key.

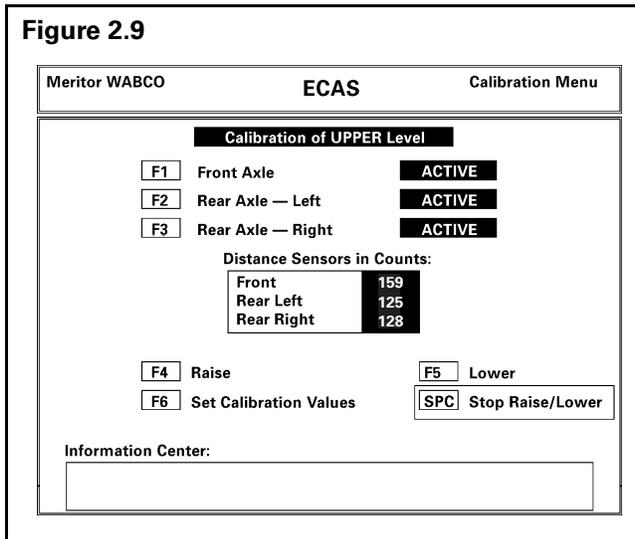
**Figure 2.8**



**Figure 2.10**



**Figure 2.9**



**Testing Components and Circuits**

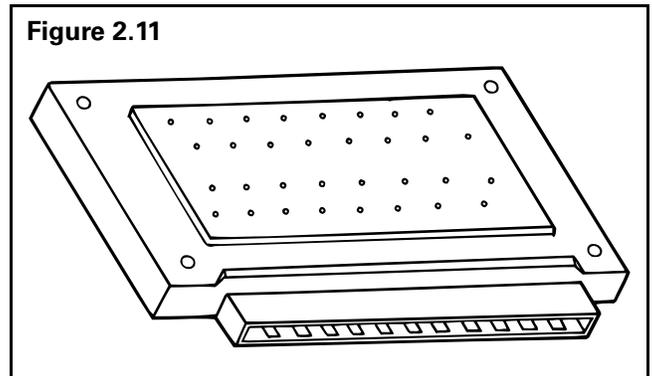
**WABCO Test Adaptor for ECAS**



When troubleshooting or testing the system at the main connector, be careful not to damage the electrical sockets.

The test adaptor allows troubleshooting of the ECAS system by providing breakout access to the circuits contained in the 35-pin connector attached to the ECU. This allows easy voltmeter measurement of voltage and resistance of ECAS wiring and components. **Figure 2.11.**

**Figure 2.11**



# Section 2 Troubleshooting and Testing

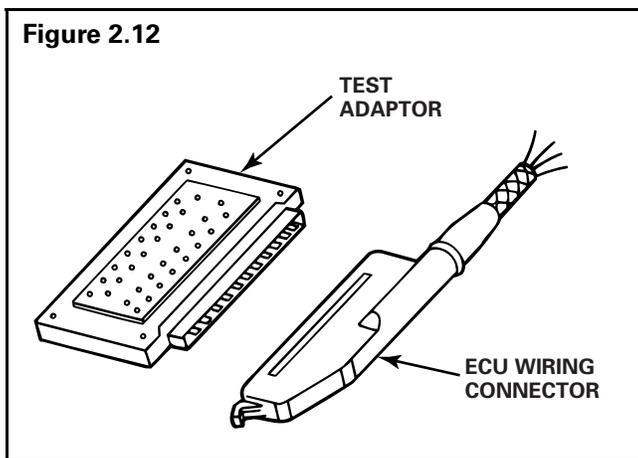
## Installing the Test Adaptor



### WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

1. Turn the vehicle ignition OFF.
2. Disconnect the 35-pin connector from the ECAS ECU.
3. Insert the test adaptor into the 35-pin connector on the ECU harness. **Figure 2.12.**



## Test Instructions

**NOTE:** Refer to the Volt-Ohm Meter (VOM) manufacturer's instructions on how to correctly use a VOM.

The following information applies to the tests presented in **Table C.**

1. Before you perform any checks listed in **Table C:**
  - Refer to the "Ignition Status" column of the table. The vehicle's ignition may be required to be either in the ON or OFF position. The engine does not have to be running.
  - Check that the air system pressure is between the compressor cut-in and cut-out pressure.
2. Set the VOM to the appropriate setting that will accommodate the expected readings listed in the "Measurement or Reaction" column of **Table C.**
3. For each step in **Table C**, compare the VOM reading or reaction with the acceptable values or reactions listed in the "Measurement or Reaction" column. Write down the results of your comparisons.
4. Repair or replace wiring or components when a meter reading or reaction is different from the one listed in the "Measurement or Reaction" column of **Table C.**
  - Confirm that repairing or replacing the component provides the correct "Measurement or Reaction."

**Table C: Test Adaptor Guide**

Check	Ignition Status	Adaptor Pins	Measurement or Reaction	Possible Cause of Malfunction
<b>ECAS Power Supply</b>				
Voltage to ECU	ON or OFF	1 and 27	18-30 volts DC	Blown fuse Power to ECU interrupted Constant power to ECU
Voltage to ECU	ON	9 and 27	18-30 volts DC	
<b>ECAS Lamps and Switches</b>				
Ride fault lamp	ON or OFF	33 and 27	Lamp comes on	Miswiring to lamp Burned out bulb
High ride lamp	ON	35 and 9	Lamp comes on	Miswiring to lamp Burned out bulb
Low ride lamp	ON	14 and 9	Lamp comes on	Miswiring to lamp Burned out bulb
Kneeling lamp	ON or OFF	18 and 27	Lamp comes on	Miswiring to lamp Burned out bulb

\* Less than 2 ohms is acceptable.

**Table C: Test Adaptor Guide (continued)**

Check	Ignition Status	Adaptor Pins	Measurement or Reaction	Possible Cause of Malfunction
Brake light switch	ON or OFF	7 and 27	0 volts when brake is NOT applied 18-30 volts when brake is applied	Miswiring to switch Defective switch
Parking brake switch	ON or OFF	10 and 27	0 ohms with parking brake applied open circuit with parking brake released*	Miswiring to switch Defective switch
Transmission neutral switch	ON (engine running)	28 and 27	0 ohms with transmission in neutral open circuit in gear*	Miswiring to switch Defective switch
Door sensor	ON or OFF	5 and 27	Open circuit to ground when door open 0 ohms when closed*	Miswiring to sensor Defective sensor
ECAS Switches	ON or OFF	Check for pin locations on wiring diagram in Section 4	Open circuit to ground when switch is ON 0 ohms when switch is OFF*	Miswiring to switch Defective switch
<b>ECAS Audible Alarms</b>				
ECAS dash alarm	ON	11 and 9	Buzzer sounds	Miswiring to alarm Defective alarm
Exterior kneeling alarm or lamp	ON	12 and 9	Buzzer sounds or Lamp comes on	Miswiring to alarm or lamp Defective alarm Burned out bulb
<b>ECAS Height and Speed Sensors</b>				
Front height sensor resistance	ON or OFF	26 and 27	100-140 ohms	Broken wire between ECU and sensor Incorrect sensor connection Defective sensor
Left rear height sensor resistance	ON or OFF	25 and 27	100-140 ohms	
Right rear height sensor resistance	ON or OFF	8 and 27	100-140 ohms	
<b>ECAS Valve</b>				
ECAS valve coil resistance	ON or OFF	13 and 27 15 and 27 30 and 27 31 and 27	60-90 ohms	Interrupted wiring between ECU and valve connector Ground lead to valve interrupted Shorted valve coil
<b>ECAS Solenoid Valve Functions</b>				
Refer to Checking ECAS Solenoid Valve Function in this section. Use a VOM with a minimum 10-amp current rating.				
ECAS valve deflates left rear air bag	ON	Connect 13 and 9	Left rear air bag deflates	Miswiring to valve Incorrect valve plumbing
ECAS valve deflates right rear air bag	ON	Connect 31 and 9	Right rear air bag deflates	
ECAS valve deflates front air bag	ON	Connect 30 and 9	Front air bag deflates	
ECAS valve inflates left rear air bag	ON	Connect 13 and 15, touch that wire to 9	Left rear air bag inflates	Incorrect valve plumbing Miswiring to valve
ECAS valve inflates right rear air bag	ON	Connect 31 and 15, touch that wire to 9	Right rear air bag inflates	
ECAS valve inflates front air bag	ON	Connect 30 and 15, touch that wire to 9	Front air bag inflates	

\* Less than 2 ohms is acceptable.

### Checking ECAS Solenoid Valve Function



#### **WARNING**

**To avoid serious personal injury and damage to the vehicle's suspension system, you must follow these instructions when you test ECAS solenoid valve function.**

1. Connect the ECAS solenoid valve to power by briefly touching (2-3 seconds **ONLY**) the appropriate VOM probe to the designated pin location. If you allow the solenoid valve to remain connected to power, serious personal injury can result from movement of the vehicle chassis. Damage to the vehicle suspension system, shock absorbers and air bags can also result.
2. You must be ready to observe immediate test results as soon as you touch the appropriate VOM probe to the pin location.



#### **WARNING**

**All personnel must be clear of the vehicle before you begin to troubleshoot ECAS. Serious personal injury can result when the vehicle chassis moves up and down.**

3. When you deflate the air bags during ECAS solenoid valve function tests, the vehicle chassis will move **DOWN** quickly as the air bags deflate.
4. When you inflate the air bags during ECAS solenoid valve function tests, the vehicle chassis will rise quickly as the air bags inflate.

### Disconnecting the Test Adaptor

1. If the ignition is **ON** from previous testing, turn it **OFF** before you disconnect the test adaptor.
2. Reconnect the 35-pin connector to the ECU.

### Vehicle Inspection

After completing the procedures on the Test Adaptor Guide and any required repairs, perform the following inspection procedures:

1. Verify that ECAS will bring the bus to the normal ride height position. When the bus is in this position, the **HIGH RIDE** or **LOW RIDE** indicator lamp will go **OFF**.
2. If the indicator lamp remains **ON**, check the height sensor linkage for correct installation (refer to OEM maintenance documents).
3. Check that the **ABS** indicator lamp does not remain **ON**.

## Removal and Installation



### WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

**Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury can result.**

## ECU Replacement

Replacing the ECU requires ECAS calibration using either the WABCO Diagnostic Controller or PC Diagnostic Program.

**NOTE:** Refer to the vehicle manufacturer's service literature for ECU location and removal/installation procedures.

### Removal

1. Apply the parking brake.
2. Turn the ignition to the OFF position and set the parking brake.
3. Remove any covers and equipment that restrict access to the ECU.
4. Disconnect wiring connector from the ECU.
5. Remove fasteners that attach the ECU to the bus.

### Installation

1. Install the ECU.
2. Attach wiring connector to the ECU.
3. Tighten fasteners to vehicle manufacturer's specification.
4. Replace any covers and equipment that were removed to gain access to the ECU.
5. Recalibrate the ECAS system. See the instructions in Retrieving Faults.

## Valve Block Replacement



### WARNING

**Release all air from the suspension system before you remove any components. Pressurized air can cause serious personal injury.**

**NOTE:** Refer to vehicle manufacturer's service literature for solenoid valve location and removal/installation procedures.

### Removal

1. Apply the parking brake.
2. Turn ignition to the OFF position.
3. If necessary, raise the vehicle off the ground and put safety stands under the chassis.
4. Disconnect the wiring connectors from the valve block.
5. Relieve air line pressure by bleeding air from the appropriate supply tank.
6. Mark the air lines for reference when installing new valve block.
7. Disconnect the air lines from the valve block.
8. Loosen the mounting bolts that attach the valve block to the mounting bracket (if used).
9. Remove the valve block from the mounting bracket or vehicle.

### Installation



### CAUTION

**Do not exceed 44 lb-ft (60 N·m) when tightening the air line connections. Excessive tightening could damage the valve block. **

1. Attach the new valve block to the mounting bracket (if used) or to the vehicle.
2. Install the mounting bolts and tighten to 76 lb-in (8.5 N·m). 
3. Connect the air lines to the valve block as marked during the removal process.
4. Connect the wiring connectors to the valve block.
5. Test the valve block functions. Refer to the Test Adaptor Guide (ECAS Solenoid Valve Functions) in Testing Components and Circuits.

## Section 3 Component Replacement

**WABCO**

### Valve Block Test

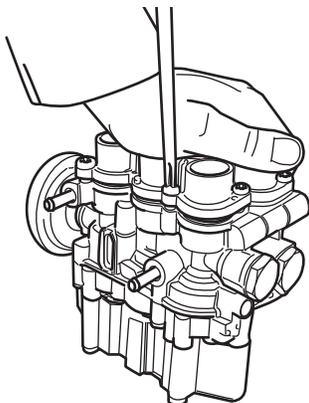
After installing a valve block, perform the following test procedure:

1. Turn the ignition to the ON position.
2. Fully charge the air system.
3. Press the NORMAL RECOVER switch on the dash panel to fill the air bags. This will place the ECAS system at the normal level.
4. Turn the ignition to the OFF position.
5. Listen for leaks at the valve block air line connections.
6. Use the RIDE HEIGHT switch to raise and lower the vehicle height, checking for correct operation under the following conditions:
  - Parking brake released
  - Transmission NOT in neutral (engine running)
  - Door closed
7. Use the KNEEL switch to place the vehicle in the kneeling position, checking for correct operation under the following conditions:
  - Parking brake engaged
  - Transmission in neutral
  - Door closed
8. Repair if necessary.

### ECAS Valve Plate Replacement

To replace the valve plates, you must first remove the ECAS valve block from the vehicle, remove the valve end caps from the valve block and remove the old valve plates from the ECAS valve. **Figure 3.1.**

**Figure 3.1**

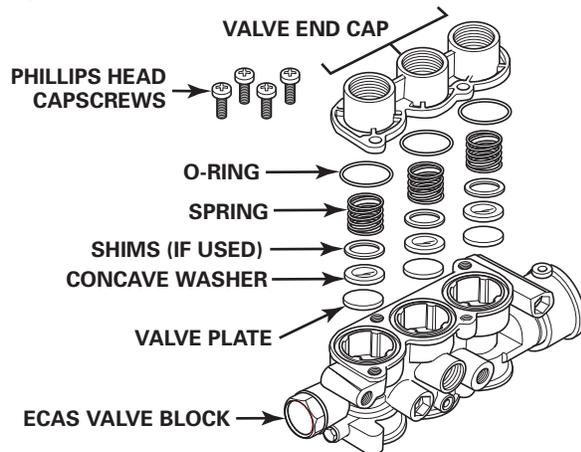


1. Remove the ECAS solenoid valve block from the vehicle. Refer to Valve Block Replacement in this section.

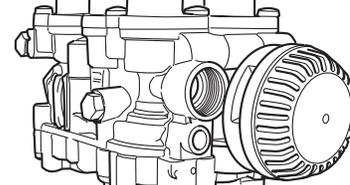
**NOTE:** The two valve end caps are not the same. Remove one valve end cap and replace the seats on that side of the valve before removing the second end cap.

2. Remove the valve end caps from the valve block.
  - A. Securely clamp the valve in a vise. Protect the plastic solenoid bodies from the vise jaws.
  - B. Loosen the four capscrews that hold the end cap in place.
  - C. Press down on the end cap to hold the springs in place as you remove the capscrews. The springs under the end cap are longer than the capscrews. Approximately 60 pounds (27 kg) of force is required to retain the end cap in position as the screws are removed. **Figure 3.2.**

**Figure 3.2**



VALVE END CAPS  
(TWO PER ECAS  
VALVE BLOCK)



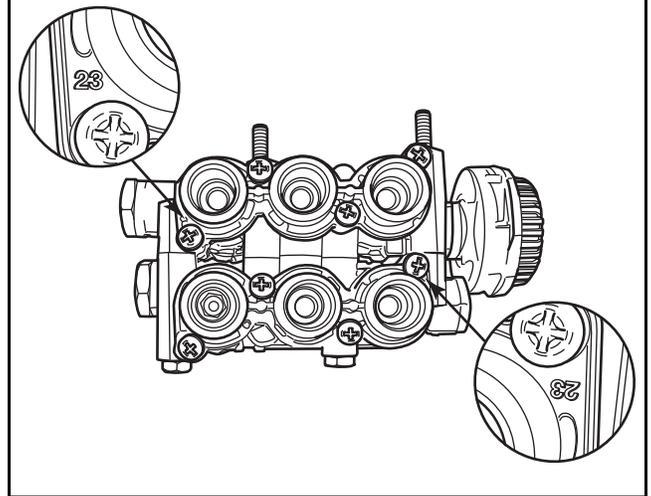
SOLENOIDS (2)

- D. Carefully remove the end cap from the valve body. Leave the springs in the bores.
  - E. Remove and discard the O-rings from each of the bores.
3. Remove the old valve plates from the bores.

**NOTE:** If shims are used, note the location. Shims **MUST** be returned to the same bore.

- A. Remove the spring, spring shim (if used), concave washer and valve plate from each bore. Each bore will contain a different size spring. Note the size and bore location of each spring and mark for reference during reinstallation.
  - B. Retain the springs and washers for use in reassembly. Discard the used valve plates.
4. Install the new valve plates in the bores.
- A. Remove any debris from the empty bores. If necessary, use a mild solvent to clean the bores, springs and washers.
  - B. Use the grease included in the replacement kit to lightly coat both sides of the concave washers, replacement O-rings and replacement valve plates.
  - C. Install a replacement valve plate in each of the bores. Install plate with rubber side **DOWN**.
  - D. Install a concave washer in each of the bores. Install with the domed side of the washer toward the aluminum face of the valve plate (domed side will face the center of the valve block).
  - E. If spring shims were used, install the shims. Shims must be returned to the same bore.
  - F. Install springs in each of the bores. Check to ensure the right size spring is installed in each bore.
5. Replace the end caps.
- A. Place the end cap over the springs.
  - B. Verify the orientation of the cap based on the numbers cast into the end cap. **Figure 3.3.**

**Figure 3.3**



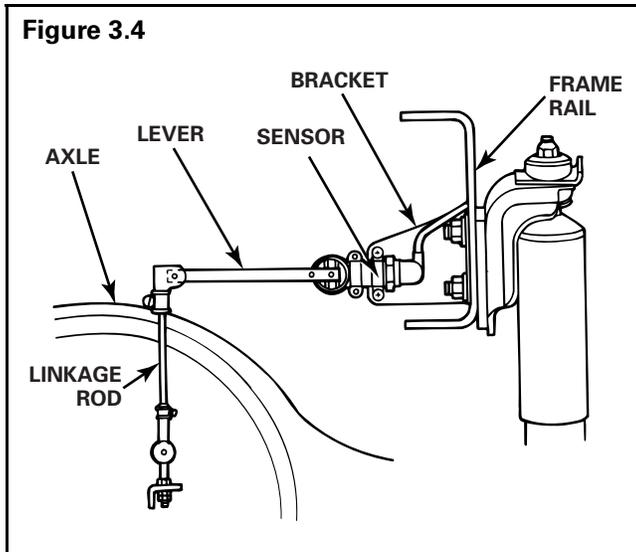
- C. Press the end cap down. Install the capscrews.
  - D. Tighten the end cap capscrews to  $4.4 \pm 0.2$  lb-ft (6.0-0.9 N•m). 
  - E. Repeat Steps 2, 3, 4 and 5 for the second end cap.
6. Replace the ECAS solenoid valve block. Refer to Valve Block Replacement in this section.

## Section 3 Component Replacement

**WABCO**

### Height Sensor Replacement

The ECAS height sensors are mounted between the frame rail and the axle housing. **Figure 3.4.** Replace a height sensor only if the diagnostic process indicates a faulty sensor. Replacing a sensor requires ECAS calibration using the WABCO Diagnostic Controller or the PC Diagnostic Program.



### Removal

1. Turn ignition to the OFF position.
2. Disconnect the wiring connector from the height sensor.
3. Remove the lever from the height sensor. Note the position of the large ribs on the sensor cylinder. **Figure 3.5.**
4. Remove the bolts that attach the sensor to the mounting bracket on the frame rail.
5. Remove the height sensor.

### Installation

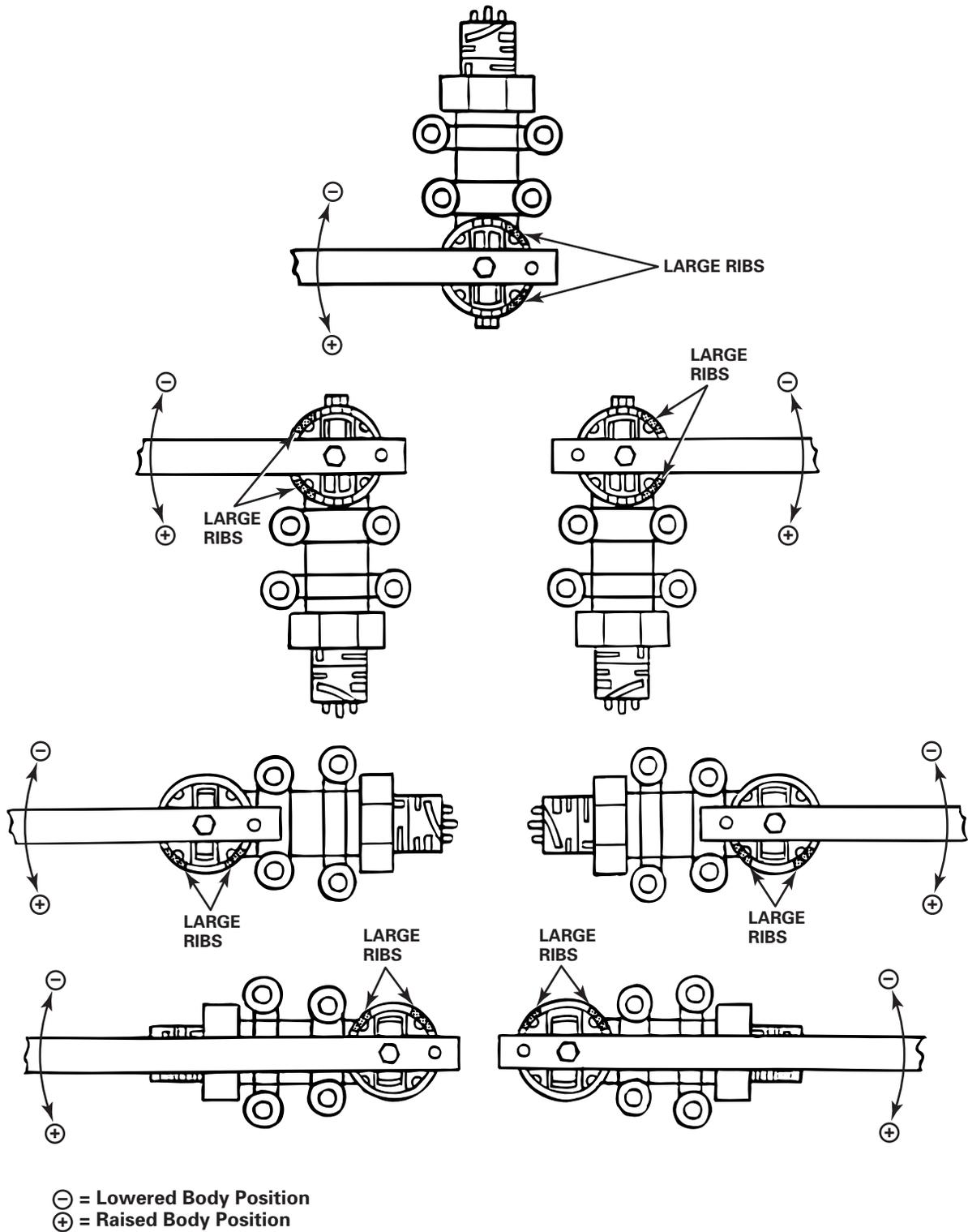
1. Position the sensor on the mounting bracket on the frame rail.
2. Install the height sensor mounting bolts and tighten to 9 lb-ft (12 N•m) or the vehicle manufacturer's specifications. **T**
3. Attach the lever to the height sensor. Tighten the lever-to-sensor bolt to 31 lb-in (3.5 N•m).



When attaching the lever to the height sensor, the large ribs on the sensor cylinder must be aligned correctly with the lever. Refer to **Figure 3.5** for correct alignment with different sensor orientations.

4. Connect the wiring connector to the height sensor.
5. Calibrate the height sensor. Refer to page 12 if you are using the WABCO test adaptor. Refer to page 14 if you are using PC diagnostics.

Figure 3.5

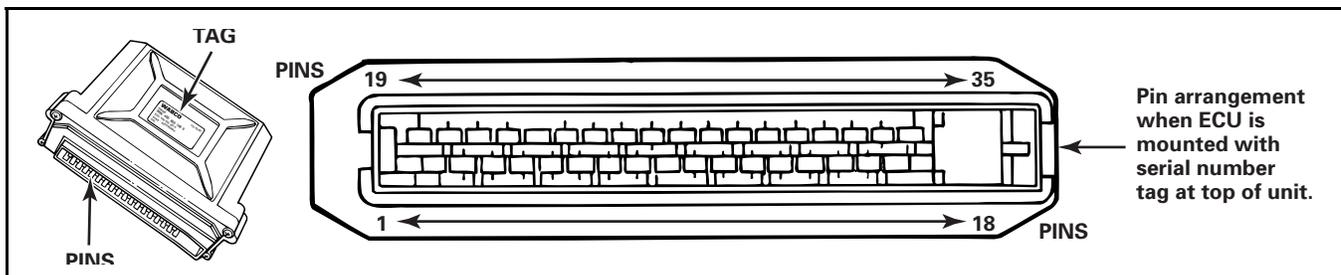
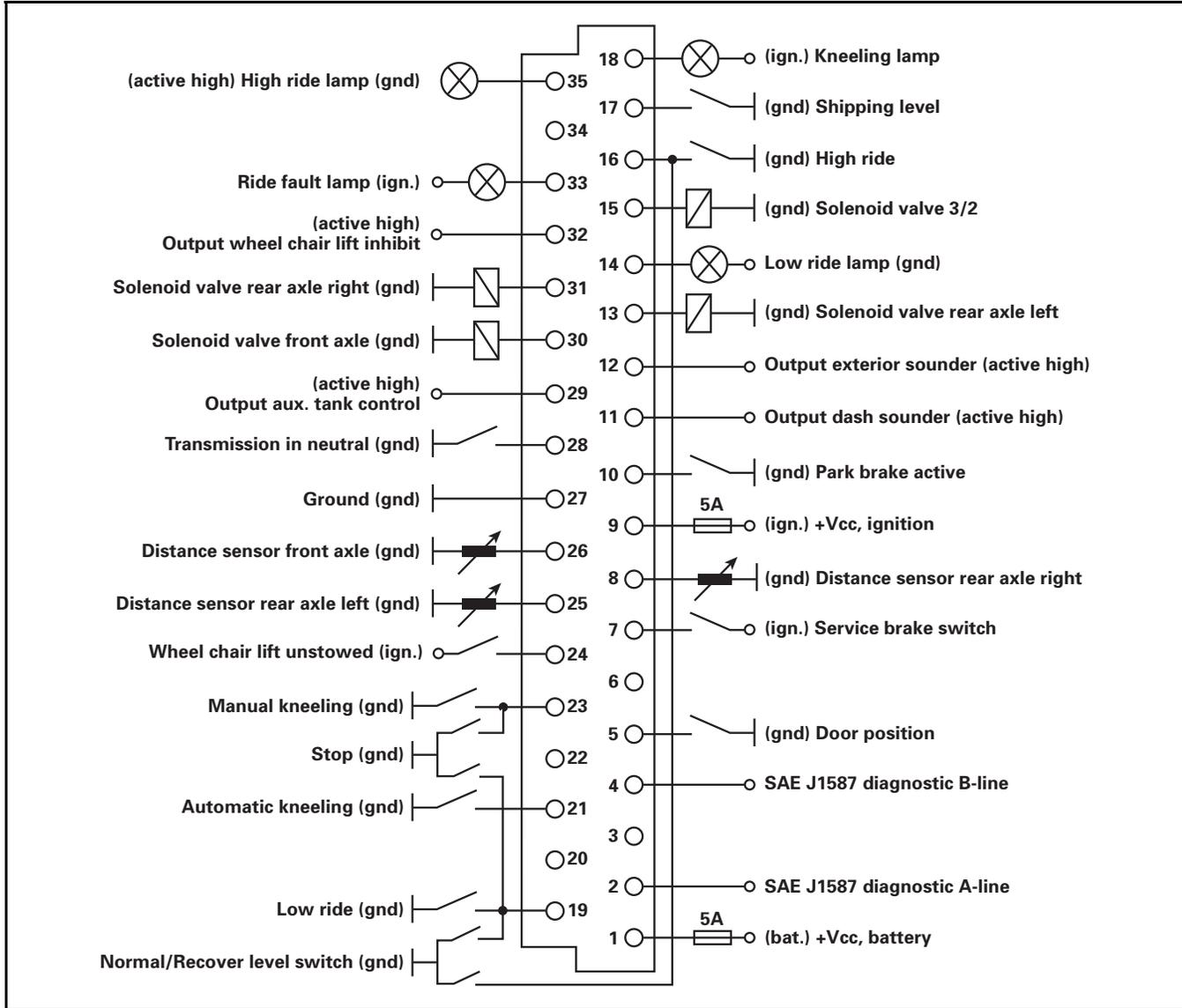


# Section 4 Wiring Diagrams



## Wiring Diagrams

### ECU Pinouts



## Diagnostic Program

### WABCO DOS-Based Diagnostic Program

In order to run any WABCO DOS-based diagnostic program from Windows® 95, it is necessary to unload most of Windows 95 when exiting to DOS. Simply running in a "DOS window" does not free up the resources required for the diagnostic programs to function correctly. The following steps can be used to create a shortcut icon to exit to DOS while unloading most of Windows 95 in the process.

#### Shortcut to DOS

##### To create a DOS icon from Windows:

1. Start Windows® 95.
2. Right click on the desktop.
3. Left click "New."
4. Left click "Shortcut."
5. In the "Create Shortcut" dialog box left click "Browse."
6. Left click "Command.com" (usually found at the bottom of the C: drive).
7. Left click "Open."
8. Left click "Next."
9. In the "Select a Title for the Program" dialog box, type "MW Diagnostics."
10. Left click "Finish."
11. Right click on the newly created "MW Diagnostics" icon.
12. Left click "Properties."
13. Left click "Program."
14. Left click "Advanced."
15. Select the "MS-DOS mode" box.
16. Unselect the "Warn before entering MS-DOS mode" box.
17. Left click "OK."

##### To install/run the WABCO Diagnostics Software:

1. Double click on the "MW Diagnostics" icon on the Windows 95 desktop (this will unload most of Windows 95 and shell you out to DOS).
2. Install or run the MW Diagnostics program from DOS.
3. To return to Windows 95, type "exit" (this will reload Windows 95).





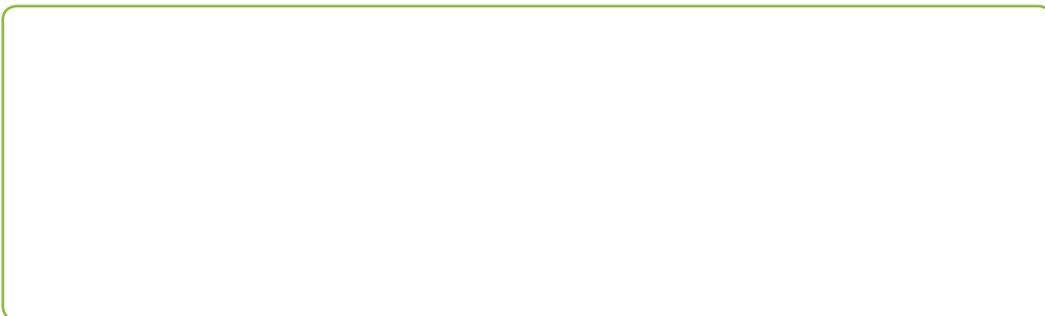


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