$2.50

Trailer ABS

Enhanced Easy-Stop™ with PLC Trailer ABS Training Program

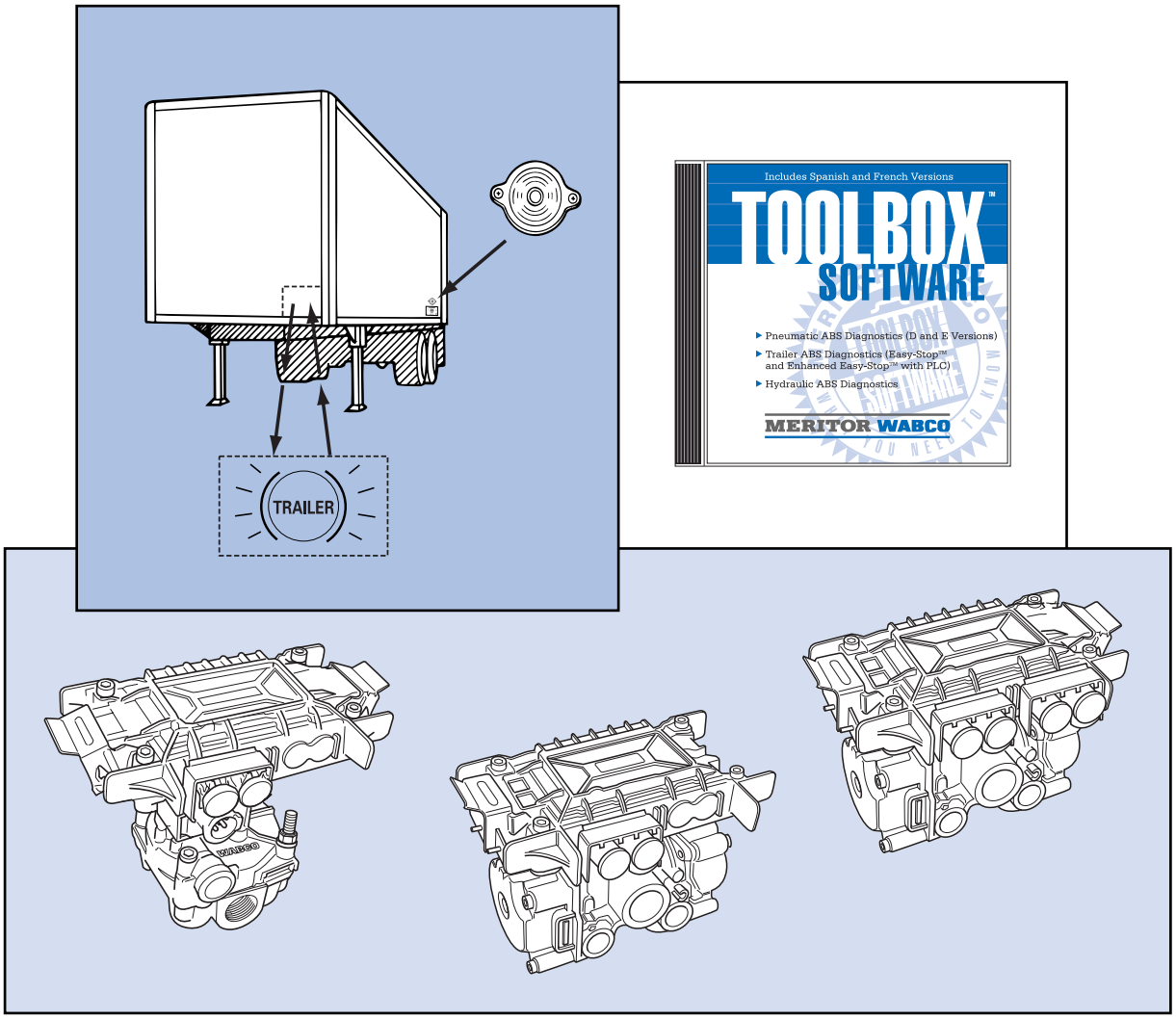
MERITOR WABCO

TP-0143
Issued 12-01

Module 1 — General Information

Module 2 — Diagnostics and Repair

Student Manual



Enhanced Easy-Stop™ with PLC Trailer ABS

STUDENT MANUAL

For MERITOR WABCO Enhanced Easy-Stop™ Trailer ABS ECUs:

P/N 400 500 101 0 2S/IM Basic for Standard Trailers
P/N 400 500 104 0 2S/IM Basic for Dollies, Turntables and Steerables
P/N 400 500 102 0 2S/2M Standard
P/N 400 500 103 0 2S/2M, 4S/2M, or 4S/3M Premium

Module 1
General Information

MERITOR WABCO

Contents

Description

This course provides a description of the Meritor WABCO Enhanced Easy-Stop™ Trailer Anti-Lock Brake System (ABS). The course will explain the system's individual components and present troubleshooting and repair information.

For service information, refer to Meritor WABCO Maintenance Manual MM-0180.

For information regarding replacement parts, refer to Meritor WABCO Parts Book, PB-96133.

For additional assistance, contact the Meritor WABCO Customer Service Center at 800-535-5560.

Objectives

The object of this training is to provide you with a basic understanding of Enhanced Easy-Stop™:

- How it works
- Major components
- Troubleshooting
- Testing
- Component replacement procedures

Upon completion of this course, you will be able to:

- Locate all system components
- Describe all system components and their functions
- Diagnose system faults
- Remove and install components

Content

This course consists of two modules:

- The first module describes Meritor WABCO Enhanced Easy-Stop™ Trailer ABS and explains how it works. It includes a description of the components that make up the system, as well as system configurations
- The second module describes diagnostics, diagnostic tools and provides instruction in the following areas:
  - Locating the cause of the problem
  - Repairing the problem
  - Checking the system for proper operation before returning it to service

This module introduces Enhanced Easy-Stop™ Trailer ABS. It describes the system and identifies the components. A description of how Enhanced Easy-Stop™ operates is also included. All of the components are discussed, as well as all of the available system configurations.

After completing this module, you will be able to:

- Explain the operation of Enhanced Easy-Stop™ Trailer ABS
- Identify and locate all of the components of Enhanced Easy-Stop™ Trailer ABS
- Recognize the different configurations of Enhanced Easy-Stop™ Trailer ABS
- Determine the location of sensors based on mounting orientation of the ECU/dual modulator valve assembly

Definition of Enhanced Easy-Stop™ Trailer ABS

Enhanced Easy-Stop™ Trailer ABS is an electronic, self-monitoring system that works with standard air brakes. It consists of three major components with connecting cables:

- Electronic Control Unit (ECU)/ABS modulator valve assembly (single or dual)
- ABS external modulator valve (for 4S/3M)
- Wheel speed sensor assembly

The ECU contains a microprocessor which controls the system. Several configurations, consisting of a different number of sensors and ABS modulator valves, make Enhanced Easy-Stop™ Trailer ABS adaptable to nearly every trailer.

Features

Enhanced Easy-Stop™ features include:

- Power Line Carrier (PLC) communication
- Generic Input and Output (I/O) (future expanded capability)
- Dual relay modulator for the 2S/2M Standard, and 2S/2M, 4S/2M and 4S/3M Premium systems
- Serviceability — ECU and valve can be replaced individually

PLC Communication

PLC stands for Power Line Carrier, which is a method used to communicate information by multiplexing data on the same wire used for the ABS electrical power. PLC communications convert signal messages data to a radio frequency (RF) signal on top of the +12V power line providing electrical power to the trailer. PLC was introduced to meet Federal Motor Vehicle Safety Standards (FMVSS) 121 requirements that call for the trailer ABS indicator lamp to illuminate on the instrument panel of the tractor to alert the driver of a fault in the trailer ABS.

Theory of Operation

The ECU receives wheel speed information from sensors located in the wheel ends of the axles. There may be two or four sensors on the trailer or dolly, depending on the number of axles and the ABS configuration.

Sensors continuously monitor wheel speed and send this information to the ECU. When a wheel starts to lock, the ECU, using the wheel-speed information and programmed data, sends output signals to control the operation of the ABS modulator valves.

The ECU monitors the air pressure in the brake chambers to prevent wheel lockup and provide precise braking control during over-braking. ABS takes over control of the air pressure only when a wheel starts to lock up. The ECU controls the ABS modulator valves to modulate air pressure to the brake chambers to prevent wheel lockup.

In the event of a malfunction in the system, the ABS in the affected wheel(s) is disabled. That wheel still has normal brakes; the other wheels keep the ABS function.

Terms and Definitions

ABS Axle Control
The 2S/1M configuration uses one ECU/modulator valve assembly and two wheel speed sensors. The ABS monitors wheel speed on one axle only. This is referred to as axle control.

ABS Side-to-Side Control
The 2S/2M and 4S/2M configurations use one ECU/dual modulator valve assembly, and two or four wheel speed sensors. ABS sensors are mounted on one or two axles only; the curb and road sides of the trailer are controlled separately. This is referred to as side-to-side control.

ABS Modulator (Relay) Valve
This solenoid controlled valve regulates air pressure at the brake chambers during ABS operation.

ABS System Configuration
The system configuration defines the number of wheel speed sensors (S) and modulator valves (M) used in the Enhanced Easy-Stop™ Trailer ABS system. These configurations are 2S/1M, 2S/2M, 4S/2M and 4S/3M.

ABS Trailer Indicator Lamp (Dash Mounted)
This lamp illuminates to alert the driver to an ABS fault in the trailer ABS.

ABS Trailer Indicator Lamp (Trailer Mounted)
This lamp illuminates to alert the driver to a fault in the trailer ABS and can be used by the service technician to display blink codes.

Dual Modulator Valve
An assembly comprised of two separate relay valves equipped with a triple solenoid. Dual modulator valves are used in 2S/2M, 4S/2M and 4S/3M installations.

ECU
An electronic device that is considered the “brains” of the system. It receives various inputs and, based on its programming, will produce various outputs. There are three types of ECUs for the Enhanced Easy-Stop™ ABS system: Basic, Standard and Premium. The differences between each one will be covered later.

Enhanced Easy-Stop™
Meritor WABCO’s next generation of trailer ABS designed to conform to the March 2001 requirements for an in-cab indicator lamp to alert the driver to malfunctions in the trailer ABS.

Generic Input/Output (I/O)
Generalized functions are used to transfer control and status information over the power line between the tractor and trailer. Typical applications include the control of lift axles, sliders, trailer tire pressure information and door-ajar status. The Enhanced Easy-Stop™ system determines the number of generic I/Os that can be supported, as follows:

System	Number of Generic I/Os That Can be Supported
Basic	1
Standard	1
Premium	5

PLC
A method of providing information and power on the same set of wires. The specific set of wires the PLC uses are the ABS-auxiliary power (blue wire) and ground (white wire). PLC communicates the trailer ABS system status to the tractor ECU that controls the in-cab trailer ABS indicator lamp.

Serviceability
The ECU can be separated from the valve assembly for replacement.

Solenoid
A wire coil with a movable core which changes position by means of electromagnetism when current flows through the coil.

TOOLBOX™ Software
A program designed to allow the technician to display Meritor WABCO ABS faults and wheel speed data, test individual components, verify installation wiring and more.

Wheel Speed Sensor
A magnetic sensing device mounted at the wheel end to measure the speed of a tooth wheel rotating with the vehicle's wheel.

ECU/Single or Dual Modulator Valve Assembly

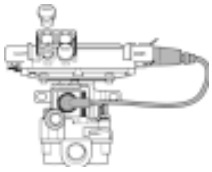
This assembly contains the trailer ABS ECU and a single or dual modulator valve.

Meritor WABCO offers three types of ECU/modulator valve assemblies:

- 2S/1M Basic with a single modulator valve
- 2S/2M Standard with a dual modulator valve
- 2S/2M, 4S/2M and 4S/3M Premium with a dual modulator valve

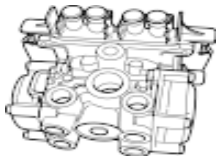
The Basic and Standard assemblies cannot be upgraded

The 3M system requires an external Modulator valve



Basic ECU/Single Modulator Valve Assembly

Standard ECU/Dual Modulator Valve Assembly



Premium ECU/Dual Modulator Valve Assembly

The ECU is the brains of the ABS. It receives and interprets the wheel speed signals from the sensors and uses this information to determine if a wheel is going to lock. It then activates the ABS modulator valve(s) to regulate air pressure to the brake chambers.

NOTE: The function of the valve and solenoid will be explained in detail in the discussion of the ABS modulator valve.

The 2S/1M Basic ECU/modulator valve assembly is used as a stand-alone system and has two wheel speed sensors and one modulator valve. The ECU/single modulator assembly (2S/1M Basic) may be mounted as one unit, or the ECU and valve may be taken apart and mounted separately. This two-sensor/one-relay valve system is recommended for converter dolly and semi-trailer applications. With one generic input/output system, the Basic meets minimum FMVSS-121 requirements providing increased vehicle stability.

ECU/Single or Dual Modulator Valve Assembly (Continued)

The 2S/2M Standard ECU/modulator valve assembly is ideally suited for single or tandem axle semi-trailer applications. Like the Basic, the Standard has one generic input/output system; however, in addition to increased vehicle stability, the Standard can provide increased protection against tire flatspotting.

The 2S/2M, 4S/2M or 4S/3M Premium system offers five generic input/output systems. Recommended applications for this Premium system include tandem axle semi-trailers, multi-axle or full trailers. This system provides the best possible protection against tire flatspotting, plus the benefits of increased braking control and stability. It also offers the greatest opportunity for monitoring and controlling trailer functions.

All three assemblies:

- Accept an external diagnostic tool for extracting blink codes and for using the Pro-Link 9000 diagnostic tool and PC-based diagnostics, Meritor WABCO TOOLBOX™ Software
- Can be replaced individually

ABS Modulator Valve

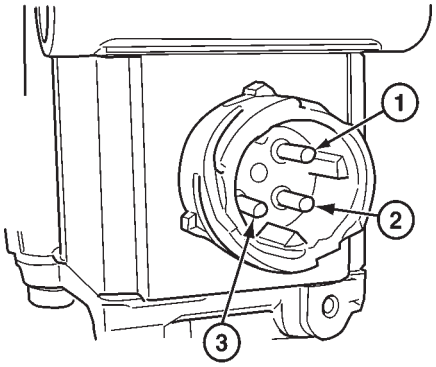
The ABS modulator valve is a solenoid-controlled relay valve, consisting of a solenoid control unit, electrically operated solenoids and a relay valve. The ECU controls the solenoids; these solenoids are extremely fast-acting. They control air pressure on the relay valve diaphragm opening or closing passages that supply the pressure to, hold the pressure in or release the pressure from, the brake chamber. At no time can this solenoid activity apply more air to the brake chambers than what the driver is asking for with the brake pedal.

There are two modulator valves in a dual modulator valve assembly, and one valve in a single modulator valve assembly. In 3M installations a third modulator valve is used, along with a dual modulator valve assembly.

ABS Modulator Valve (Continued)

The ABS modulator valves are part of the trailer air brake system. During normal (non-ABS) braking, they serve as relay valves for delivering air pressure to the brake chambers.

The ABS modulator valve regulates air pressure to each ABS-controlled brake. During normal braking, the solenoids are not activated and the valve acts as a normal relay valve. During ABS operation, the valve modulates air pressure in the brake chambers to control braking and prevent wheel lockup, as described on the following pages.



1 Exhaust Solenoid (Blue wire)
2 Inlet Solenoid (Brown wire)
3 Ground Terminal

Figure 1-1: ABS Modulator Valve with Bayonet Connector

ABS Modulator Valve (Continued)

The ABS modulator valve functions in one of four modes:

- At rest when no brakes are applied
- During normal brake application
- During ABS pressure hold
- During ABS pressure release

NOTE: The dual modulator valve has a triple solenoid design with two inlet solenoids and one common outlet solenoid.

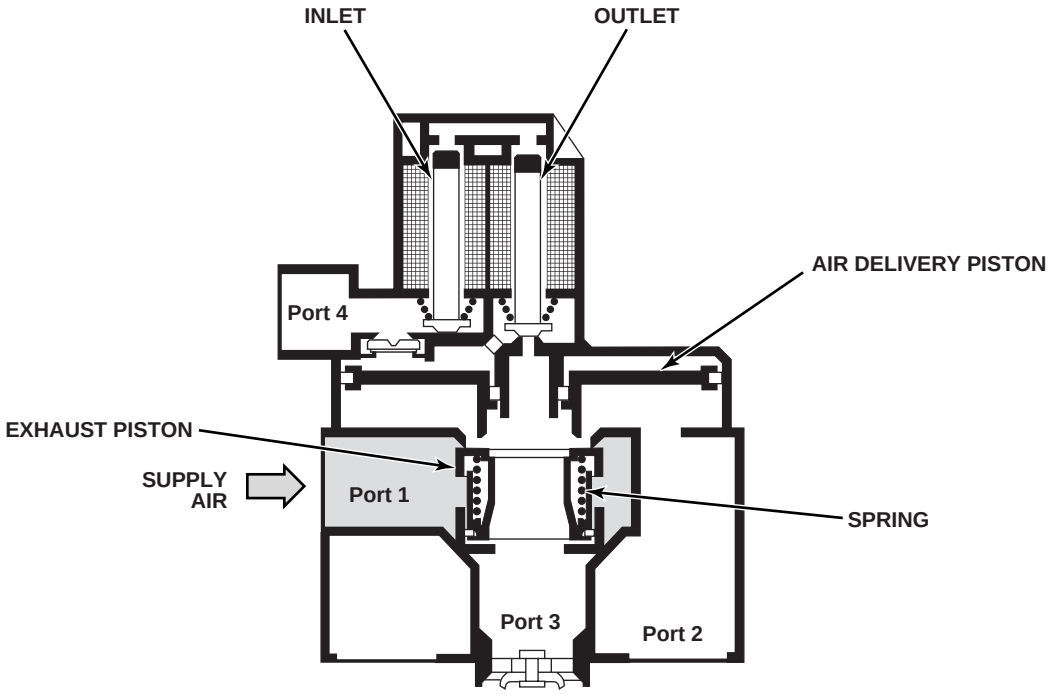


Figure 1-2: At Rest When No Brakes are Applied

In Figure 1-2, air supply pressure is present at Port 1. When the brakes are not applied, no control pressure is present at Port 4.

ABS Modulator Valve (Continued)

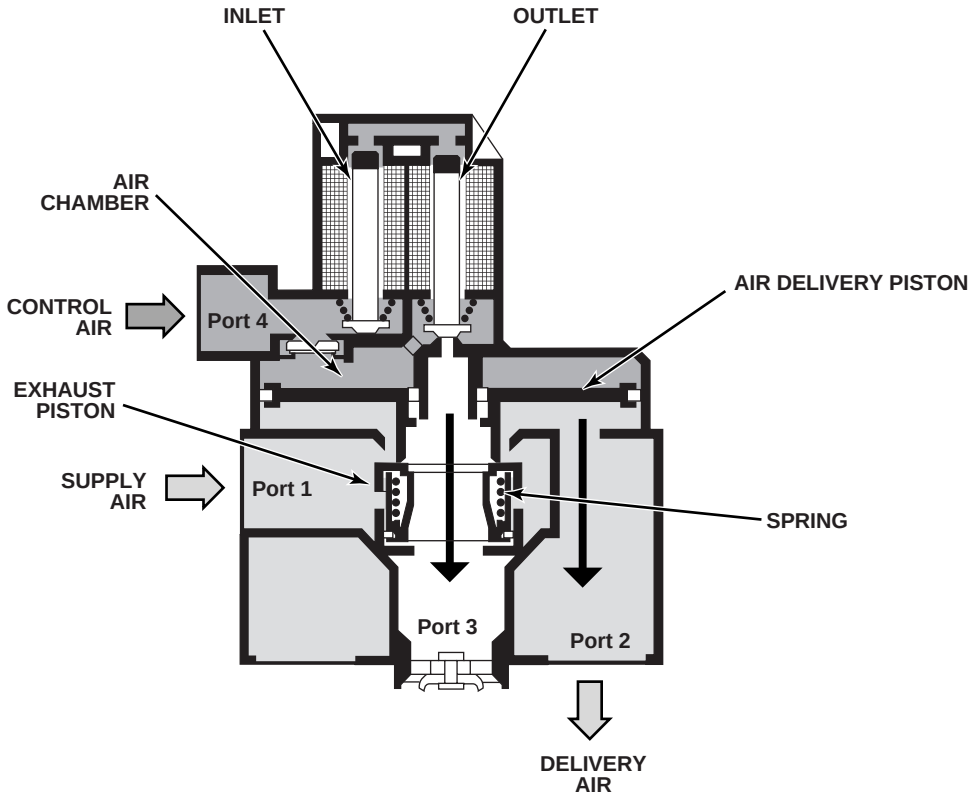


Figure 1-3: Normal Brake Application

When the brakes are applied, control pressure is applied to Port 4. Control pressure flows past the solenoids into the piston chamber, forcing the air delivery piston down.

This moves the exhaust piston downward against the tension of the spring, opening a small gap between the piston crown and the valve seal, allowing air to flow from Port 1 to Port 2 and into the brake chambers.

If control pressure is reduced, the air delivery piston moves up and excess pressure is vented through the opening of Port 3.

ABS Modulator Valve (Continued)

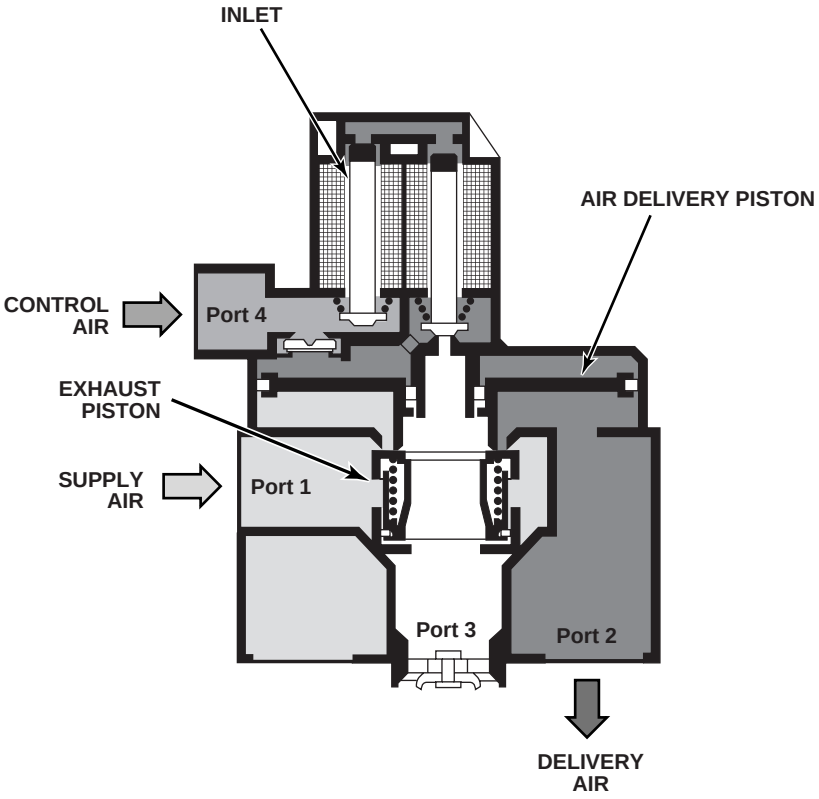


Figure 1-4: ABS Pressure Hold

When the ABS is activated, it first goes into pressure hold mode. The inlet solenoid is energized, interrupting the flow of control pressure to the air delivery piston chamber.

This causes the pressure on both sides of the exhaust piston to equalize, and the spring forces the piston upward.

This seals off Port 2. Air cannot enter it from Port 1, nor can it exhaust to the atmosphere.

ABS Modulator Valve (Continued)

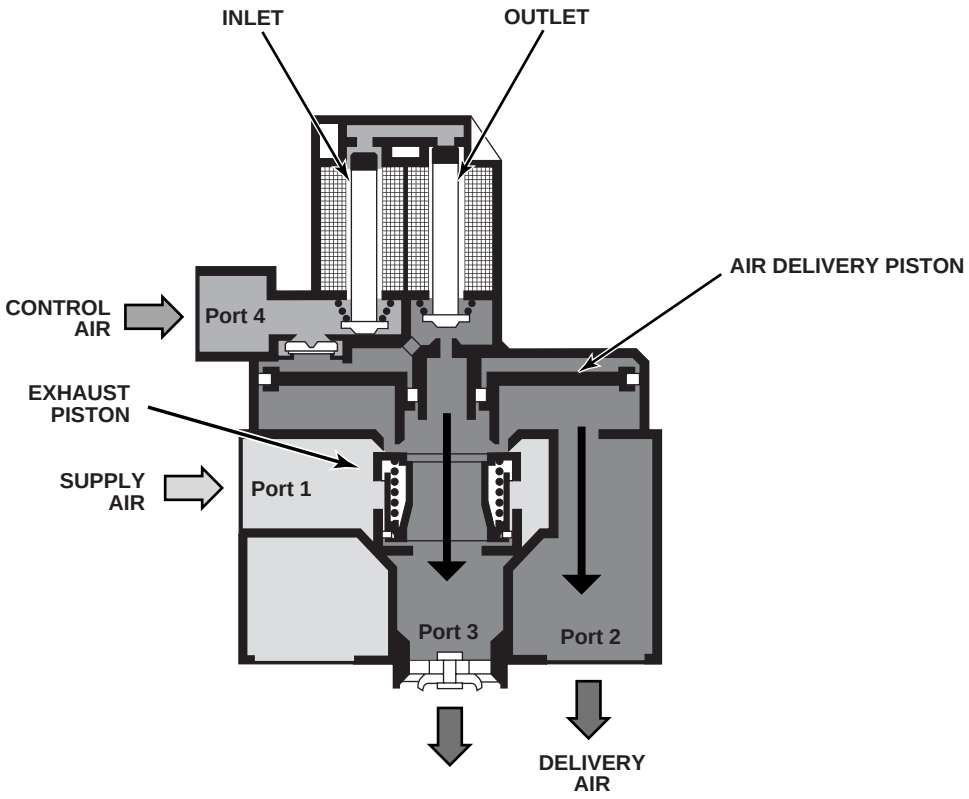


Figure 1-5: ABS Pressure Release

If the pressure hold mode does not cause the wheels to stop locking, the ABS enters pressure release mode. The inlet solenoid is de-energized, and the outlet solenoid is energized. The inlet solenoid prevents control pressure from entering the upper chamber, and vents the pressure in the air delivery piston chamber through the central opening in the piston. Both pistons are forced up, opening Port 2 to the atmosphere through Port 3.

Wheel Speed Sensor Assembly

A wheel speed sensor is installed at the wheel end of a sensed axle. To measure wheel speed, the sensor has a two-wire (twisted pair) cable with a molded-on connector. A sensor extension cable is used to connect the wheel speed sensor to the ECU. The sensor measures the speed of a tooth wheel (turning with the hub) by producing an Alternating Current (AC) voltage signal that has a frequency proportional to wheel speed.

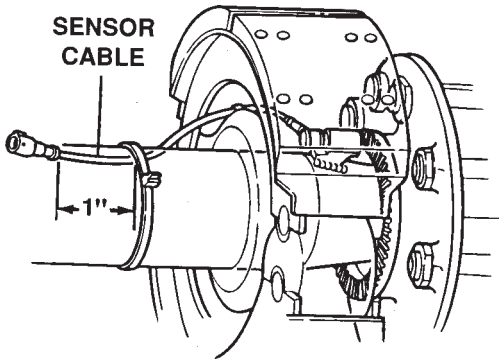


Figure 1-6: Wheel Speed Sensor Assembly

For optimum performance, the pencil-type wheel speed sensor is a completely sealed unit and is located at the axle end. A trailer may have two or four sensors. The sensors are mounted inside the brake assembly, at both ends of the axle.

On a tandem axle trailer with a two-sensor ABS, the sensors will normally be located on the axle that will lock first. This could be either the front or rear axle, and is determined by the type of suspension that is on the trailer.

Wheel Speed Sensor Assembly (Continued)

The wheel speed sensor is a magnetic pickup-type sensor. It consists of a coil wrapped around a magnet. It is positioned near the tooth wheel, which is attached to the wheel hub. As the wheel turns, the teeth (and the spaces between them) pass by the sensor. This influences the magnetic flow through the field produced by the sensor's magnet. As the magnetic flow builds and collapses with the passing of each tooth and gap, voltage pulses are created in the coil wrapped around the magnet. These pulses are sent directly to the ECU and are used to determine the relative speed of the wheel.

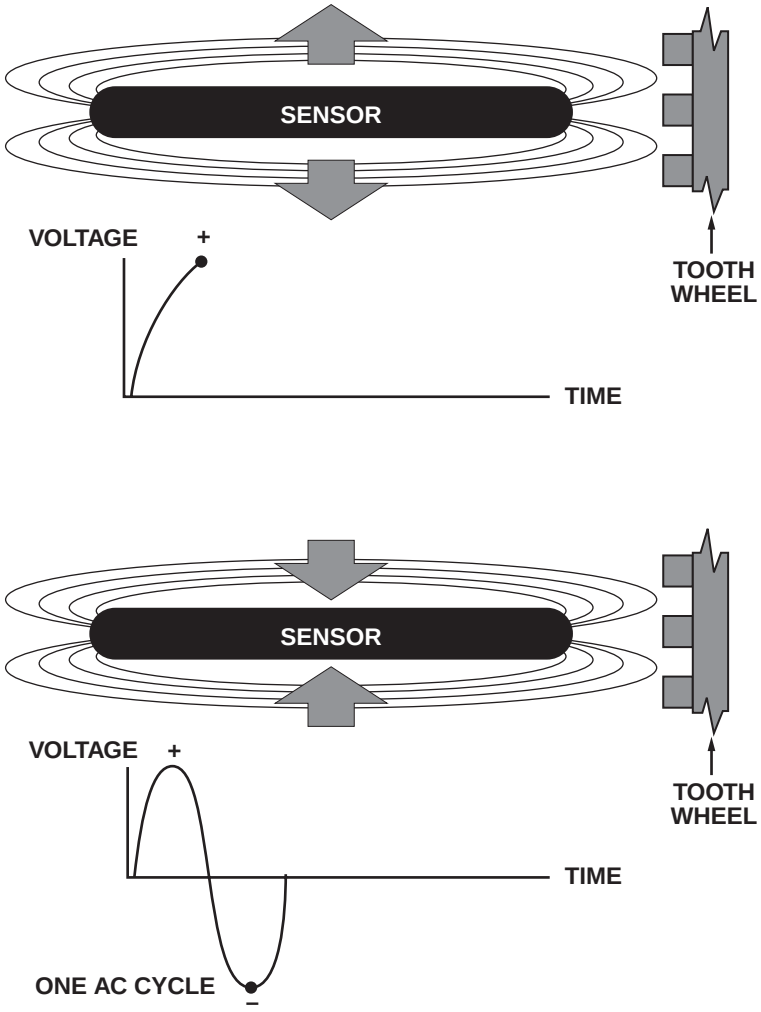


Figure 1-7: Wheel Speed Sensor Operation

Spring Clip

The spring clip holds the wheel speed sensor in place in the sensor holder, in close proximity to the tooth wheel. A Meritor WABCO sensor clip must be used to ensure a proper fit.

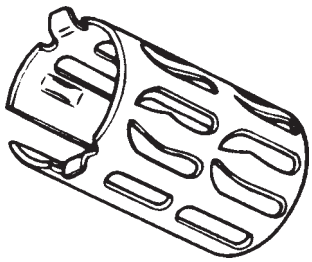


Figure 1-8: Spring Clip

Sensor Holder

The sensor holder is a metal bracket, welded to the axle so the sensor can remain in close contact with the tooth wheel. The wheel speed sensor and spring clip slide into the holder.

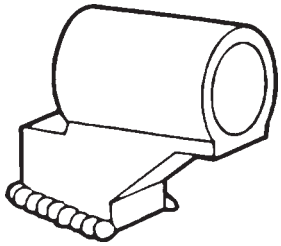


Figure 1-9: Holder

Tooth Wheel

The tooth wheel is a ring of 100 evenly spaced teeth. It is mounted on the machined surface of the hub on each sensed wheel. Usually it is pre-installed on the hub.

NOTE: Eighty-tooth wheels are available for applications in which there is a tire size differential of 15 percent or greater.

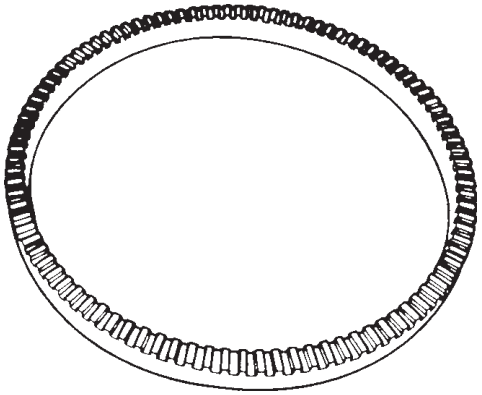


Figure 1-10: Tooth Wheel

Sensor Extension Cable

This is a two-wire (twisted pair) cable with molded connectors. It connects the wheel speed sensor to the ECU.

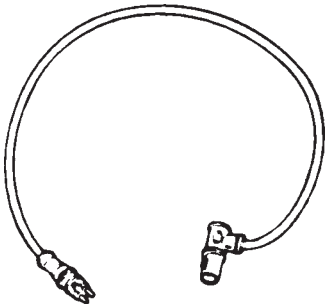


Figure 1-11: Extension Cable with Plug

TOOLBOX™ Software

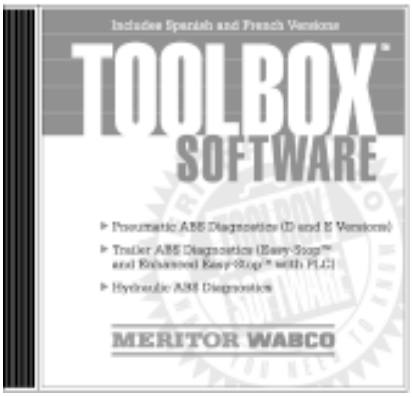


Figure 1-12: TOOLBOX™ Software

Meritor WABCO TOOLBOX™ Software is a PC-based diagnostic program. It runs in Windows® 95, 98, NT, 2000 or Me and provides diagnostic capabilities by communicating with the ECU. TOOLBOX™ Software is the preferred method of diagnosing Meritor WABCO tractor and trailer ABS. Version 4.1 (or higher) is required for Enhanced Easy-Stop™.

PLC/J1708 Adapter

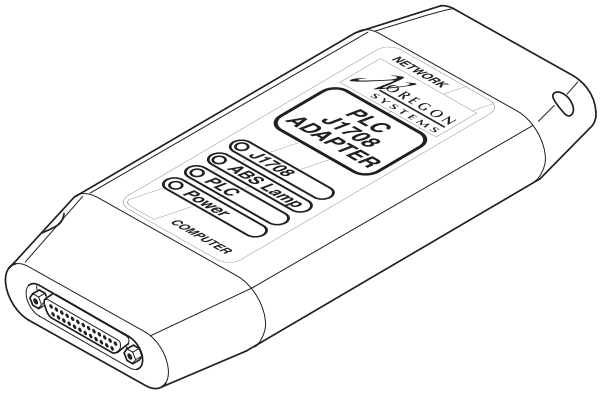


Figure 1-13: PLC/J1708 Adapter

This hand-help adapter can be used as a trailer/tractor tester to ensure the PLC is functioning properly.

Pro-Link 9000

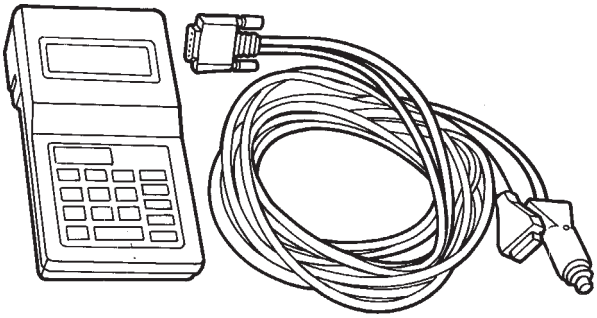


Figure 1-14: Pro-Link 9000

The Pro-Link 9000 is a diagnostic tool that can be used to troubleshoot the Meritor WABCO trailer ABS system.

Diagnostic Tool

The diagnostic tool is a sealed switch and lamp. It attaches to the SAE J1587 diagnostic connector, and is used to activate Enhanced Easy-Stop™ trailer ABS blink code diagnostics.

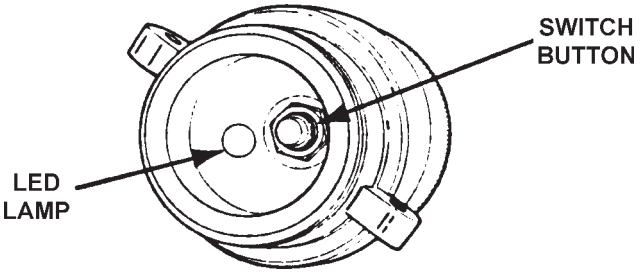


Figure 1-15: Diagnostic Tool

NOTE: For Enhanced Easy-Stop™ trailer ABS, the diagnostic tool may be used, but is not recommended. If used, the blink codes are not displayed in sequence with the ABS trailer-mounted indicator lamp. The code will appear one flash at a time, first on the indicator lamp, then on the tool. This is illustrated in the Diagnostics section, under Fault Code Check.

Important Information

When replacing the bulb in an ABS lamp, use an incandescent type, DOT-approved lamp or a Light Emitting Diode (LED) with integral load resistor.

Trailer-Mounted ABS Indicator Lamp

An indicator lamp is attached to the body of the trailer. The lamp stays lit at all times if a fault condition exists in the ABS. Using the ignition power activation procedure, this lamp can be used to read blink codes.

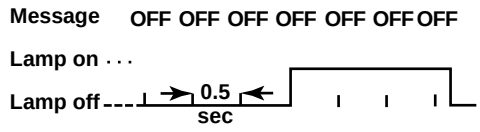
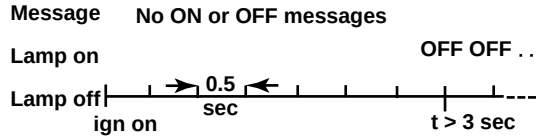
Dash-Mounted Trailer ABS Indicator Lamp

The trailer ABS in-cab indicator lamp on the vehicle dash applies to the trailer ABS only. The lamp is controlled by a signal to the tractor ECU, sent over the PLC. When a trailer ABS fault is detected, an ON message is sent. When no fault is detected, the ECU receives an OFF message. Table A illustrates trailer ABS lamp operation at power-up, or ignition ON. Table B depicts lamp responses that occur during operation. Blink codes cannot be displayed on the trailer ABS dash-mounted indicator lamp.

Lamp ON and OFF messages do not turn the lamp on or off instantly. The delay between the receipt of the message and the lamp response time is intentional. It prevents erratic lamp activity.

NOTE: For double or triple trailers, the lamp does not distinguish between trailers. A system fault in any of the trailers will activate the trailer ABS in-cab indicator lamp.

Table A: Dash-Mounted Trailer ABS In-Cab Indicator Lamp Operation — Bulb Check Driver Information

Signal from Trailer to Tractor ECU	Status of Trailer ABS Lamp on Vehicle Dash	Explanation
Single or Multiple Trailers 	Trailer ABS lamp comes on at ignition; OFF message is detected within three seconds of ignition; and Trailer ABS lamp goes out.	Bulb Check performed and Trailer ABS system is OK. In this case, the lamp is ON for a Bulb Check only.
Single or Multiple Trailers 	Trailer ABS lamp does not come on within three seconds of ignition.	No Bulb Check performed, trailer added after initial power-up, and system OK. There was no trailer PLC message for at least three seconds following ignition ON.

ON = Turn ON message to "trailer ABS" lamp
OFF = Turn OFF message to "trailer ABS" lamp
Removing a trailer with a fault will cause the ABS lamp to turn off. Remember to have the trailer with the fault repaired as soon as possible before returning to service.

Table B: Dash-Mounted Trailer ABS In-Cab Indicator Lamp Operation — Service Technician Information

Signal from Trailer to Tractor ECU	Status of Trailer ABS Lamp on Vehicle Dash	Explanation	Action
Single or Multiple Trailers Message: No ON or OFF messages Lamp on Lamp off: 0.5 sec	Trailer ABS lamp does not come on within three seconds of ignition.	Not using the PLC system (no trailer connected) or trailer not equipped with PLC or fault in PLC system.	Use lamp on side of trailer to identify fault. Make necessary repairs.
Single Trailer Message: OFF OFF OFF ON ON ON ON ON Lamp on Lamp off: 0.5 sec	Trailer ABS lamp comes on.	Trailer ABS fault(s) occurred during operation and still exists.	
Multiple Trailers/Dollies Message: OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF OFF ON ON ON ON Lamp on Lamp off: 0.5 sec			
Single Trailer Message: ON ON OFF OFF OFF OFF OFF OFF Lamp on Lamp off: 0.5 sec, t + 2.5	Trailer ABS lamp comes on but goes out after 2.5 seconds after fault is detected.	Trailer ABS fault occurred during operation and the fault was corrected.	None
Multiple Trailers/Dollies Message: OFF OFF OFF OFF OFF OFF OFF ON ON OFF OFF OFF OFF OFF OFF Lamp on Lamp off: 0.5 sec, t + 2.5			
Single Trailer Message: No ON or OFF messages ON ON ON Lamp on Lamp off: 0.5 sec, t, t + 10 sec	ABS lamp is off, comes on, then goes off, 10 seconds after loss of messages.	ABS fault existed, then signal was lost because trailer disconnected or PLC fault occurred.	Use lamp on side of trailer to identify fault. Make necessary repairs.
Multiple Trailers/Dollies Message: OFF OFF OFF OFF OFF OFF OFF ON ON Lamp on Lamp off: 0.5 sec, t + 2.5		ABS fault existed, then trailer with fault lost signal because trailer was disconnected or PLC fault occurred.	
Single Trailer to Multiple Trailers/Dollies Message: OFF OFF OFF ON ON ON ON ON ON Lamp on Lamp off: 0.5 sec	ABS lamp is on and stays on when a new trailer with no new fault is added.	There was a fault in existence before the new trailer was added and the ignition was not turned off before the trailer was added.	
Single Trailer to Multiple Trailers/Dollies Message: ON ON ON ON ON ON ON ON ON Lamp on Lamp off: 0.5 sec	ABS lamp is on and stays on when a new trailer with a new fault is added.	ABS fault was in existence before the new trailer was added and the ignition was not turned off before the trailer was added and the new trailer has an ABS fault.	

ON = Turn ON message to "trailer ABS" lamp
OFF = Turn OFF message to "trailer ABS" lamp
Removing a trailer with a fault will cause the ABS lamp to turn off. Remember to have the trailer with the fault repaired as soon as possible before returning to service.

Cables

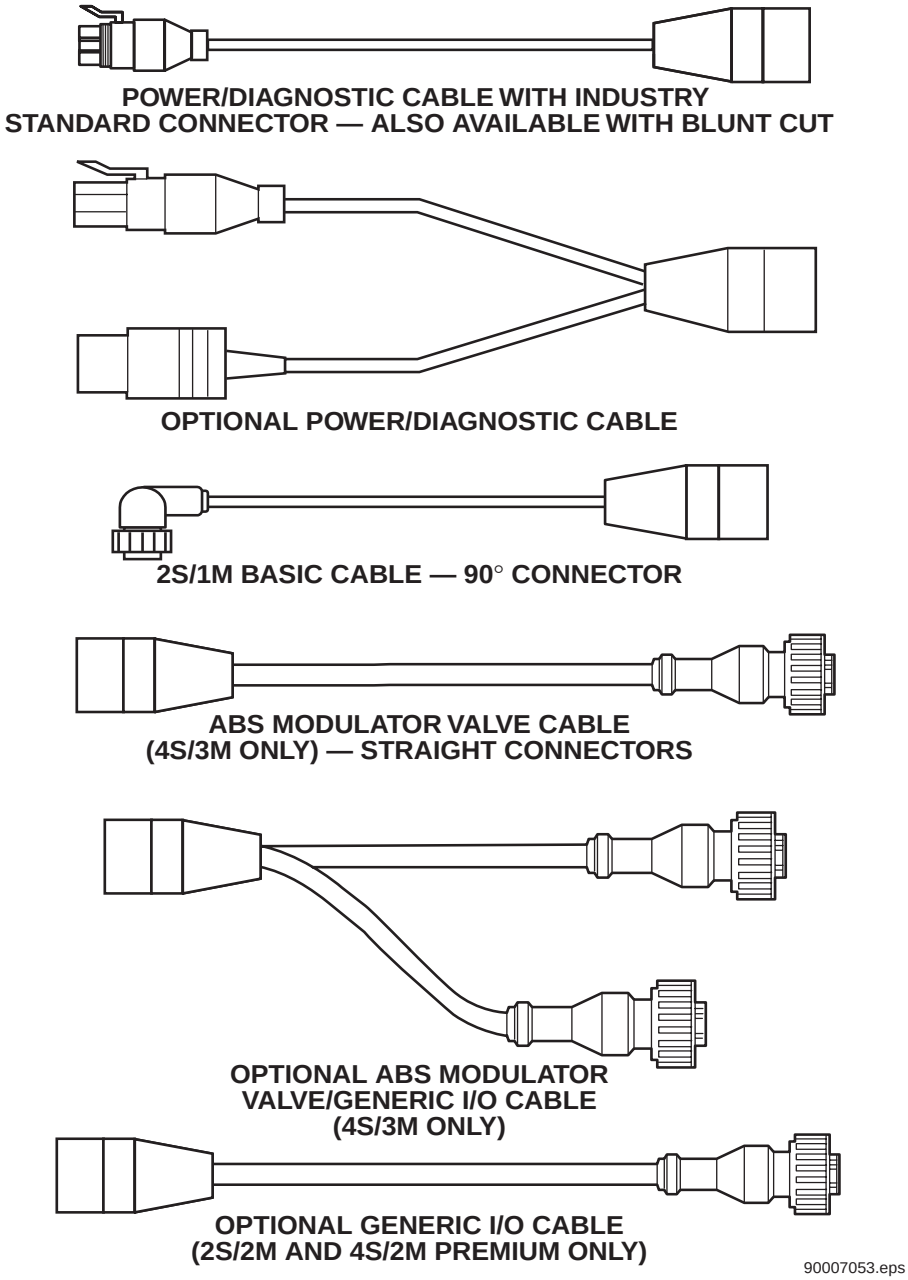
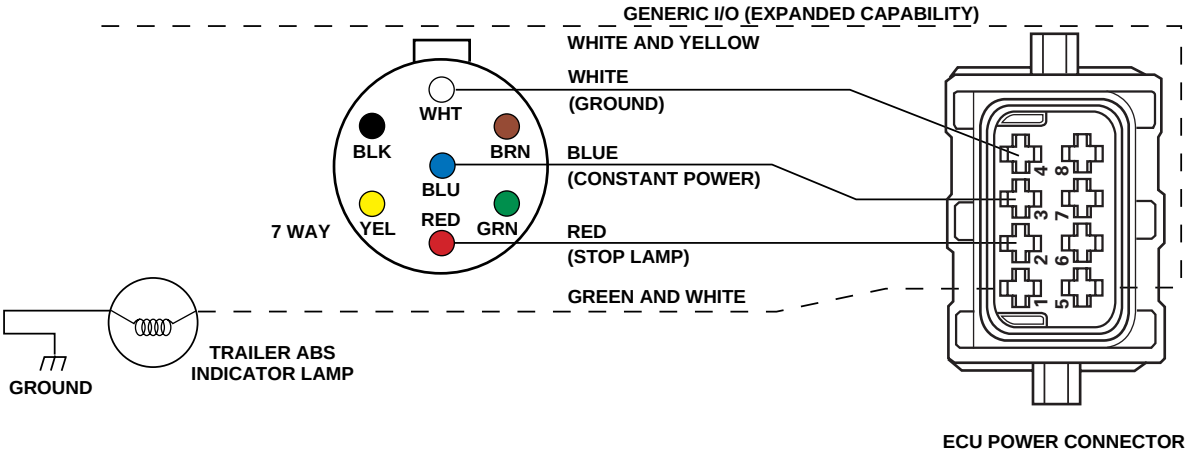


Figure 1-16: Cables for Enhanced Easy-Stop™ Trailer ABS

Wiring



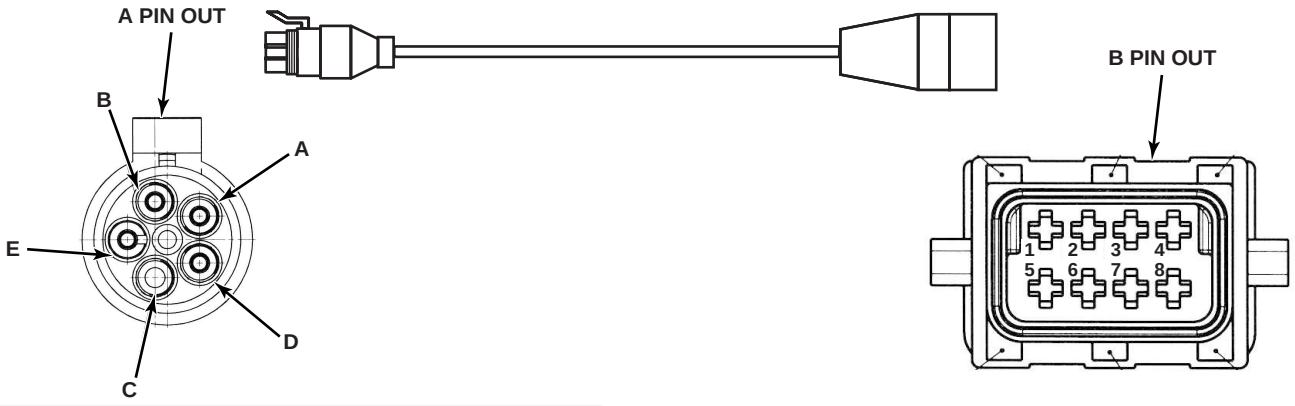
Junction box not shown

Figure 1-17: 4- or 5-Conductor Power Cable Wiring (5-Conductor Shown)

The power cable delivers power to the ECU from the trailer wiring harness. The ECU has two sources of power. It receives constant power from the blue wire, which is “hot” any time the tractor ignition switch is on. As backup, it also receives power from the stop lamp circuit (red wire). It also uses the white wire for ground and the green and white wire for controlling the ABS indicator lamp. In the case of a loss of power on the blue wire, the ABS will use power from the stop lamp circuit.

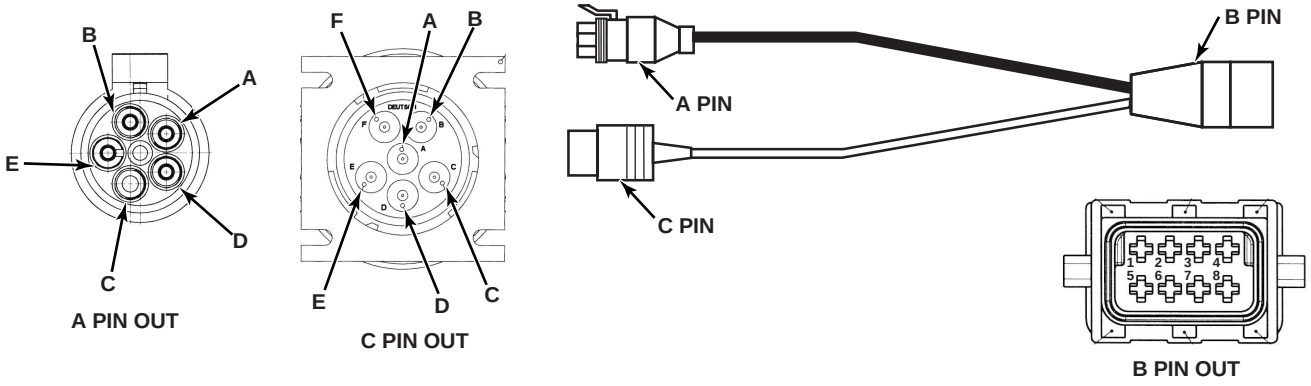
The cable has molded-on connectors at both ends. The rectangular shaped 8-pin connector attaches to the ECU. The 5-pin connector attaches to the trailer wiring harness.

An optional power/diagnostic Y-cable combines the power and diagnostic functions.



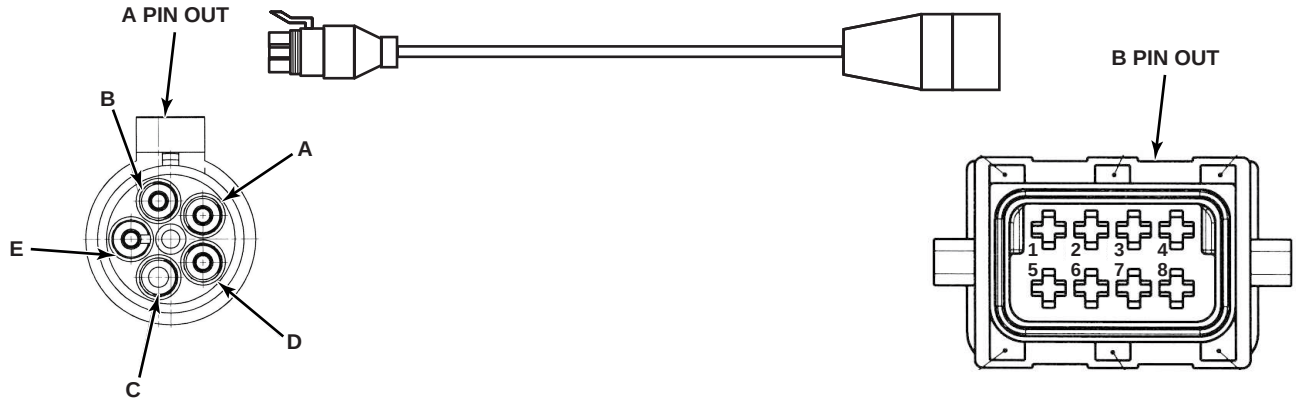
Position	Wire Color	Position	Note
A - D	White/Green	B - 1	Warning Lamp
A - A	Red	B - 2	Secondary Power
A - B	Blue	B - 3	Primary Power
A - E	White	B - 4	Ground
		B - 5	GIO 1
		B - 6	Power Out
		B - 7	SAE B
		B - 8	SAE A

Figure 1-18: 4-Conductor Power Cable with Weather Pack Connector



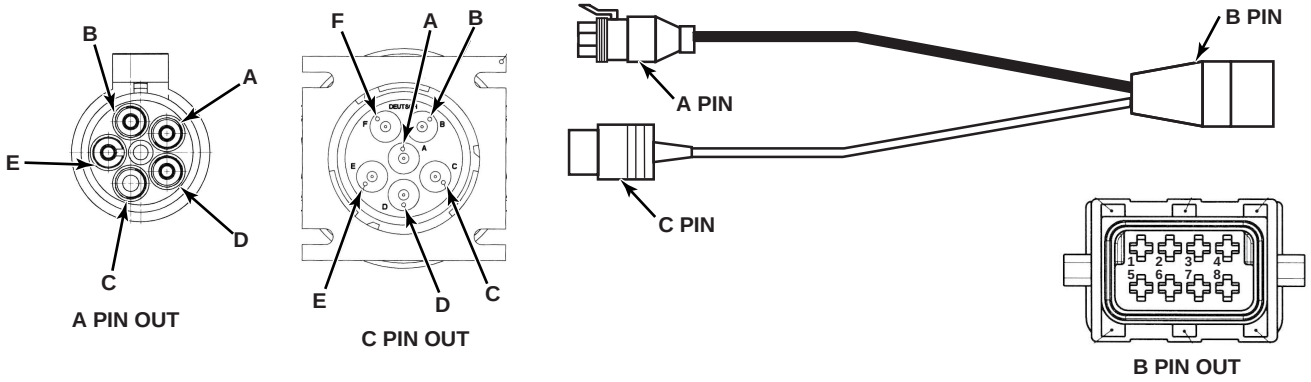
L 1		L 2			
Position	Wire Color	Position	Wire Color	Position	Note
A - D	White/Green	C - D	Yellow	B - 1	Warning Lamp
A - A	Red			B - 2	Secondary Power
A - B	Blue			B - 3	Primary Power
A - E	White	C - E	Red	B - 4	Ground
				B - 5	GIO 1
		C - C	Green	B - 6	Power Out
		C - B	White	B - 7	SAE B
		C - A	Black	B - 8	SAE A

Figure 1-19: 4-Conductor Power/Diagnostic Cable with Weather Pack Connector



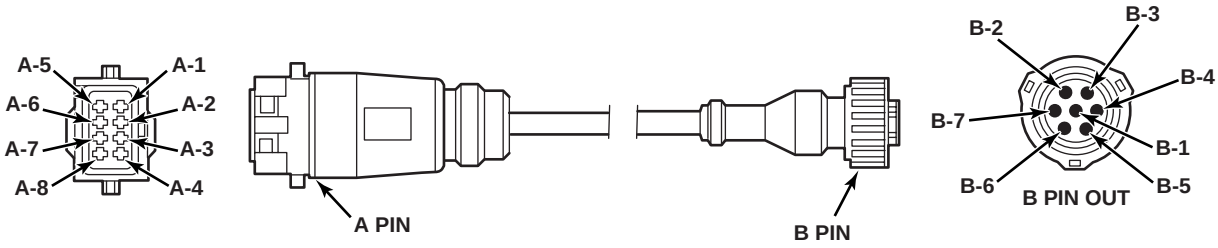
Position	Wire Color	Position	Note
A - D	White/Green	B - 1	Warning Lamp
A - A	Red	B - 2	Secondary Power
A - B	Blue	B - 3	Primary Power
A - E	White	B - 4	Ground
A - C	White/Yellow	B - 5	GIO 1
		B - 6	Power Out
		B - 7	SAE B
		B - 8	SAE A

Figure 1-20: 5-Conductor Power Cable with Weather Pack Connector



L 1		L 2			
Position	Wire Color	Position	Wire Color	Position	Note
A - D	White/Green	C - D	Yellow	B - 1	Warning Lamp
A - A	Red			B - 2	Secondary Power
A - B	Blue			B - 3	Primary Power
A - E	White	C - E	Red	B - 4	Ground
A - C	White/Yellow			B - 5	GIO 1
		C - C	Green	B - 6	Power Out
		C - B	White	B - 7	SAE B

Figure 1-21: 5-Conductor Power/Diagnostic Cable with Weather Pack Connector



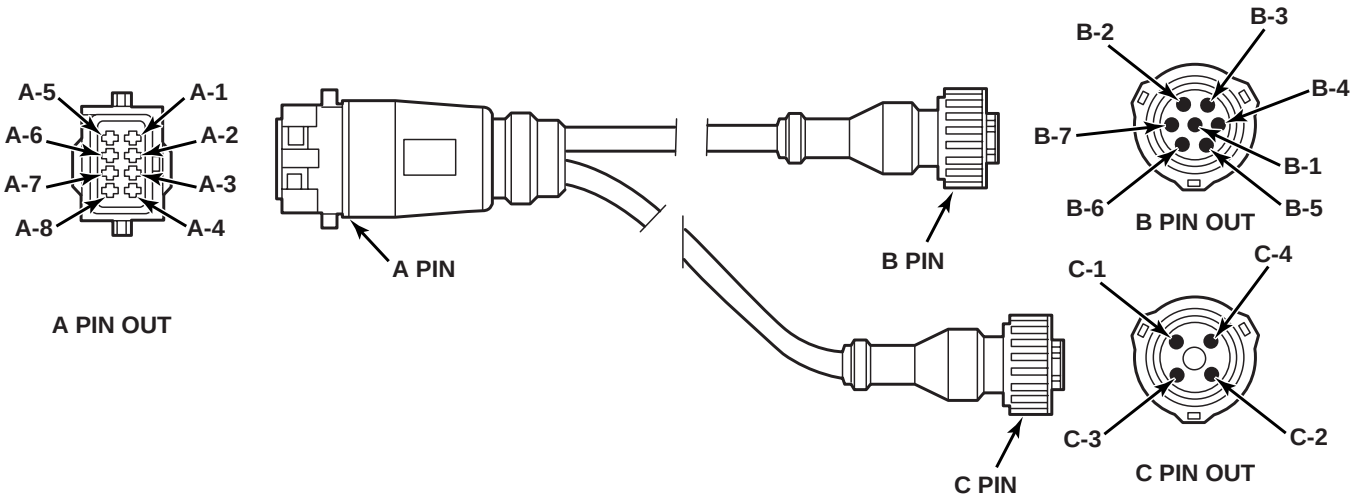
A PIN OUT

Position	Wire Color	Position	Notes
A - 1			
A - 2			
A - 3			
A - 4			
A - 5	Green/Yellow	B - 2	
A - 6	Blue	B - 1	
A - 7	Brown	B - 3	
A - 8			

Figure 1-22: 2S/1M or 4S/3M Modulator Valve Cable (90° Style Connector is Used with 2S/1M Systems)

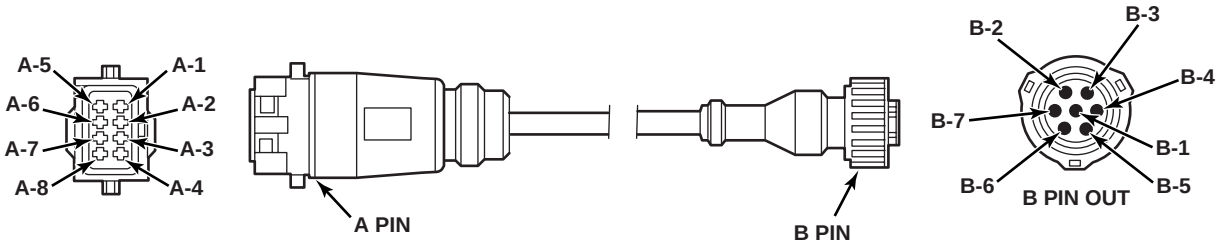
ABS Modulator Valve Cable — Generic I/O Y-Cable

The ABS modulator valve cable connects the ECU and the modulator valve. In 4S/3M systems, the generic I/O portion is for I/O support Premium systems.



Position	Wire Color	Position	Position	Wire Color	Notes
A - 1	Blue	B - 2			Generic I/O
A - 2	Black	B - 1			Generic I/O
A - 3	White	B - 3			Generic I/O
A - 4	Red	B - 7			Sensor Power Supply
A - 5	Yellow	B - 5	C - 2	Green/Yellow	Ground
A - 5	Green/Yellow	B - 4	C - 2	Green/Yellow	
A - 6	-	-	C - 1	Blue	Modulator
A - 7	-	-	C - 3	Brown	Modulator
A - 8	Brown	B - 6			Generic I/O

Figure 1-23: Optional ABS Modulator Valve/Generic I/O Cable (4S/3M Only)



A PIN OUT

Position	Wire Color	Position	Notes
A - 1	Blue	B - 2	
A - 2	Black	B - 1	
A - 3	White	B - 3	
A - 4	Red	B - 7	
A - 5	Yellow	B - 5	
A - 6	Green/Yellow	B - 4	
A - 7			
A - 8	Brown	B - 6	

Figure 1-24: Generic I/O Cable (2S/2M and 4S/2M Premium Systems Only)

Sensor Placement

With Enhanced Easy-Stop™, 2S/2M Standard and 2S/2M, 4S/2M and 4S/3M Premium sensor location designations will change depending on how the ECU/dual modulator valve assembly is mounted. It may be mounted facing either the front or the rear of the trailer. It is important that you identify the location of these sensors before beginning any diagnostics. Sensor locations for both front and rear-facing installations are depicted in Figures 1-25 through 1-33.

Sensor locations for the 2S/1M Basic will not change based upon the orientation of the valve.

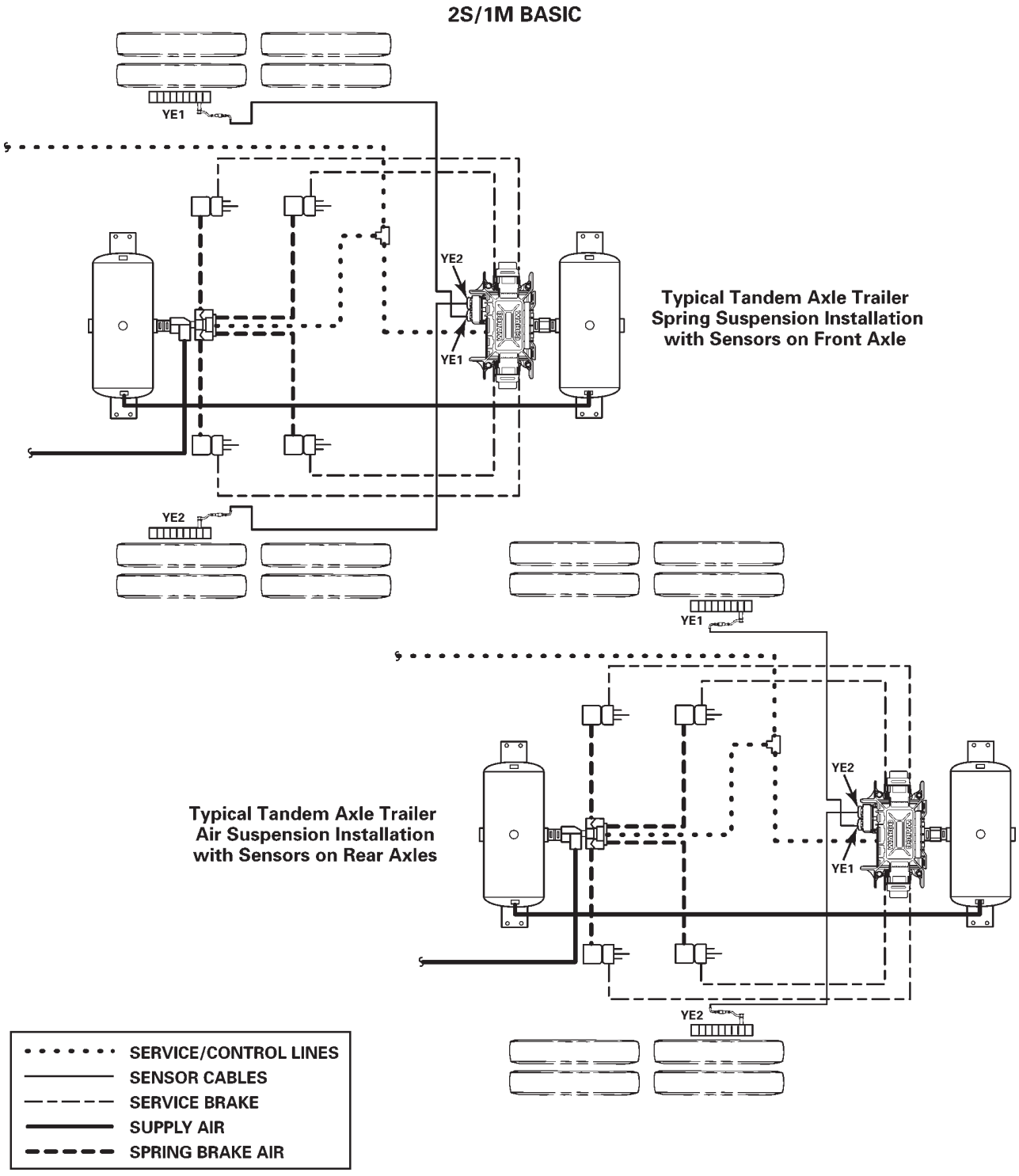


Figure 1-25: 2S/1M Basic Installation

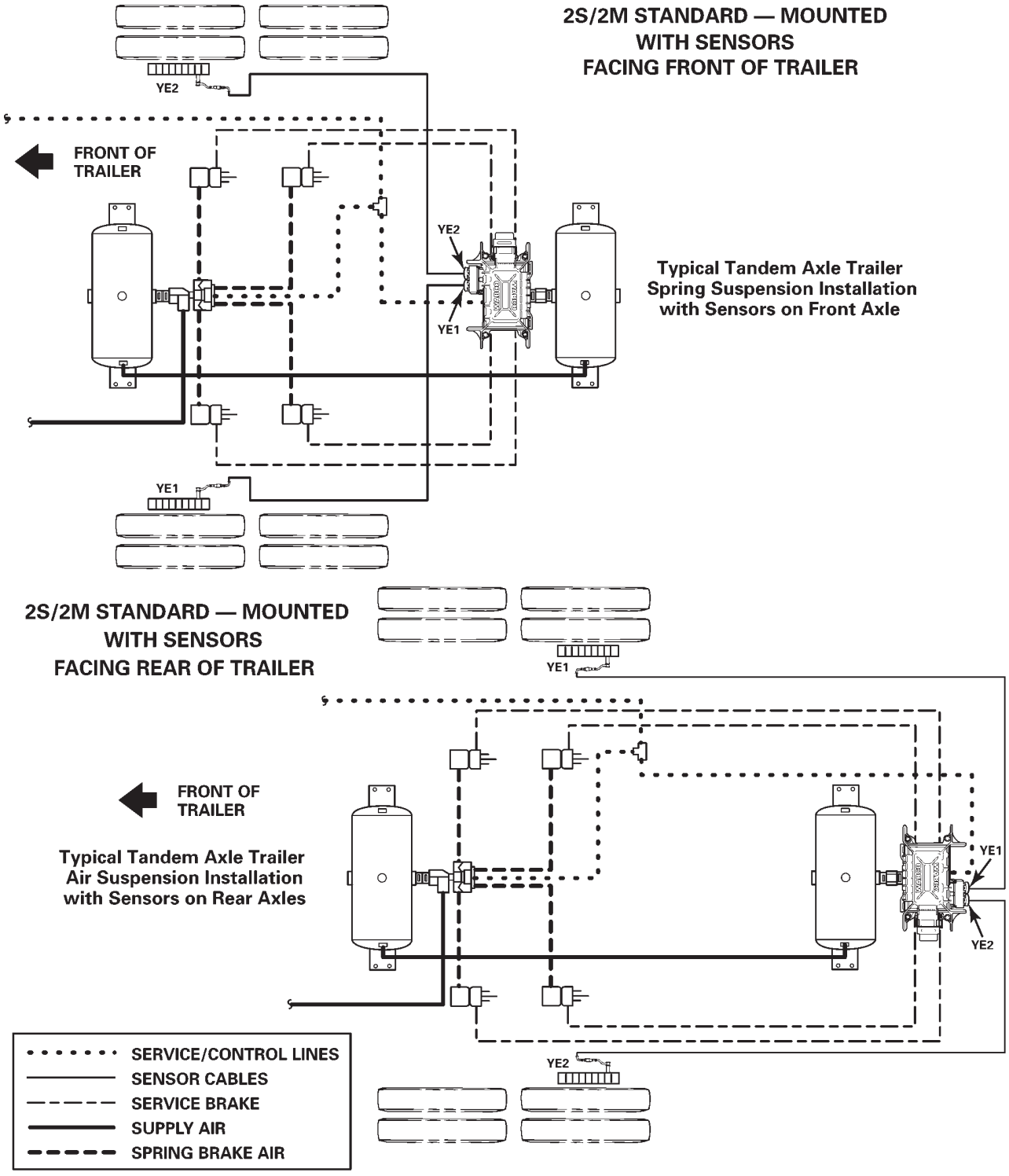


Figure 1-26: 2S/2M Standard Installation

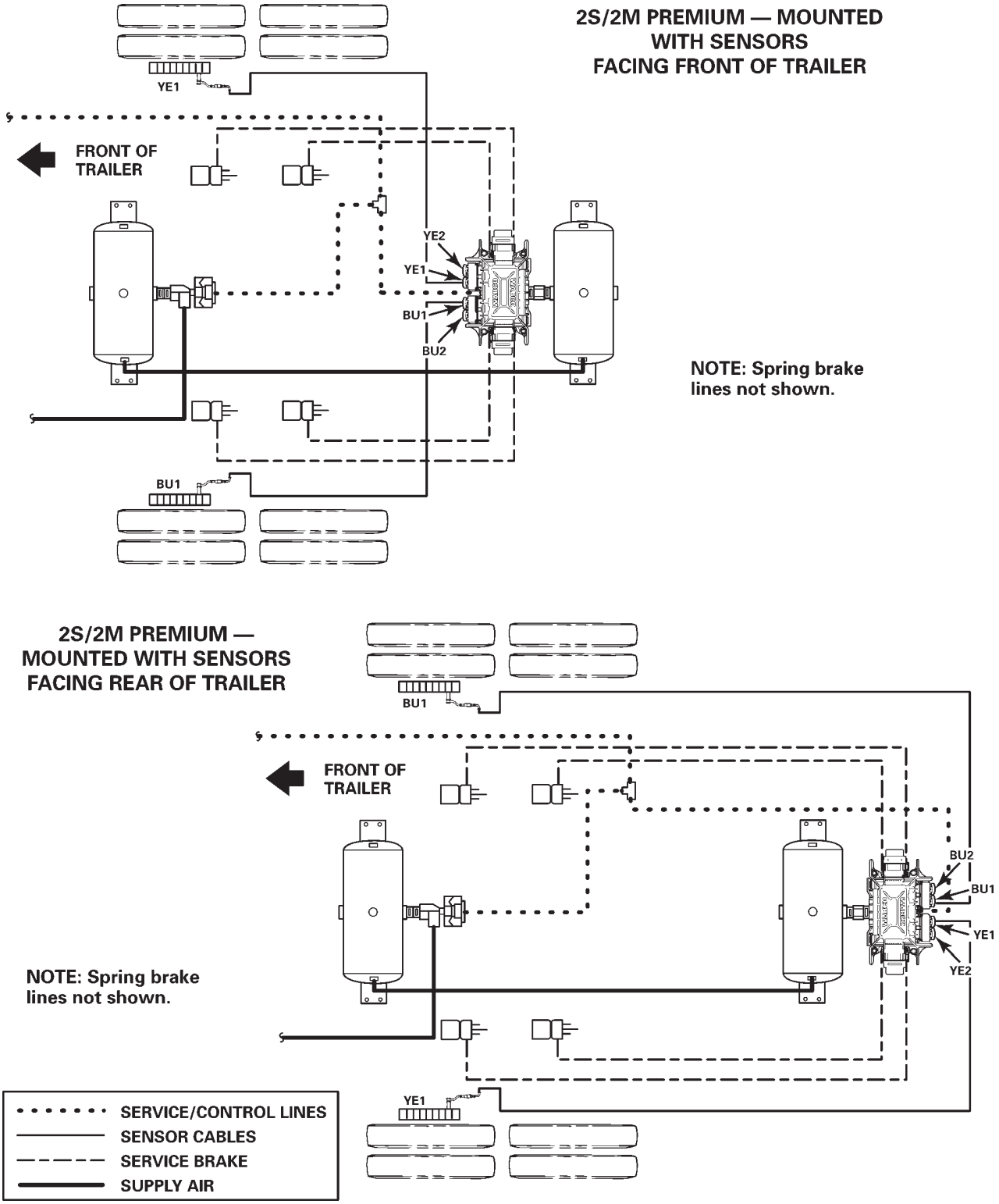


Figure 1-27: 2S/2M Premium Installation

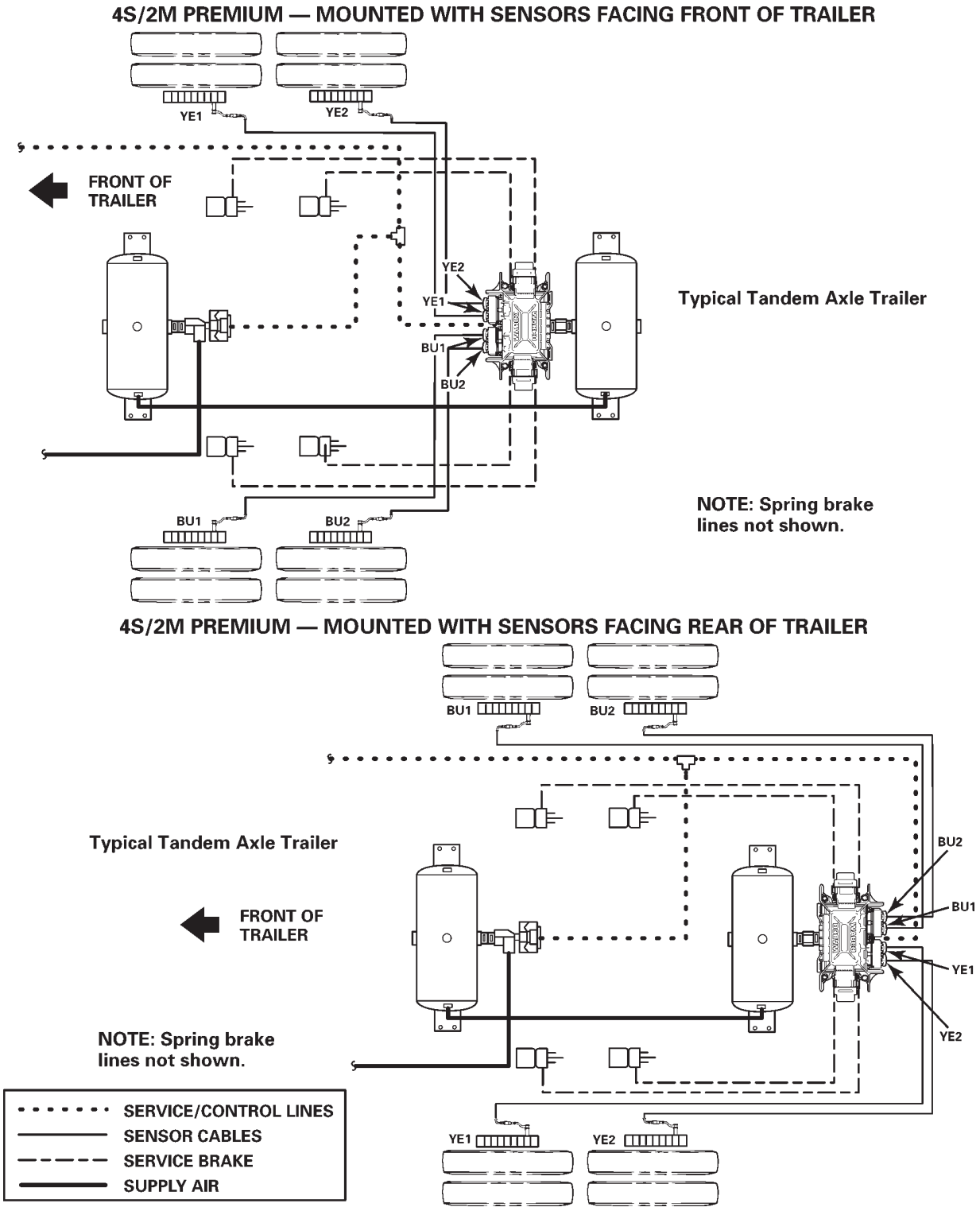
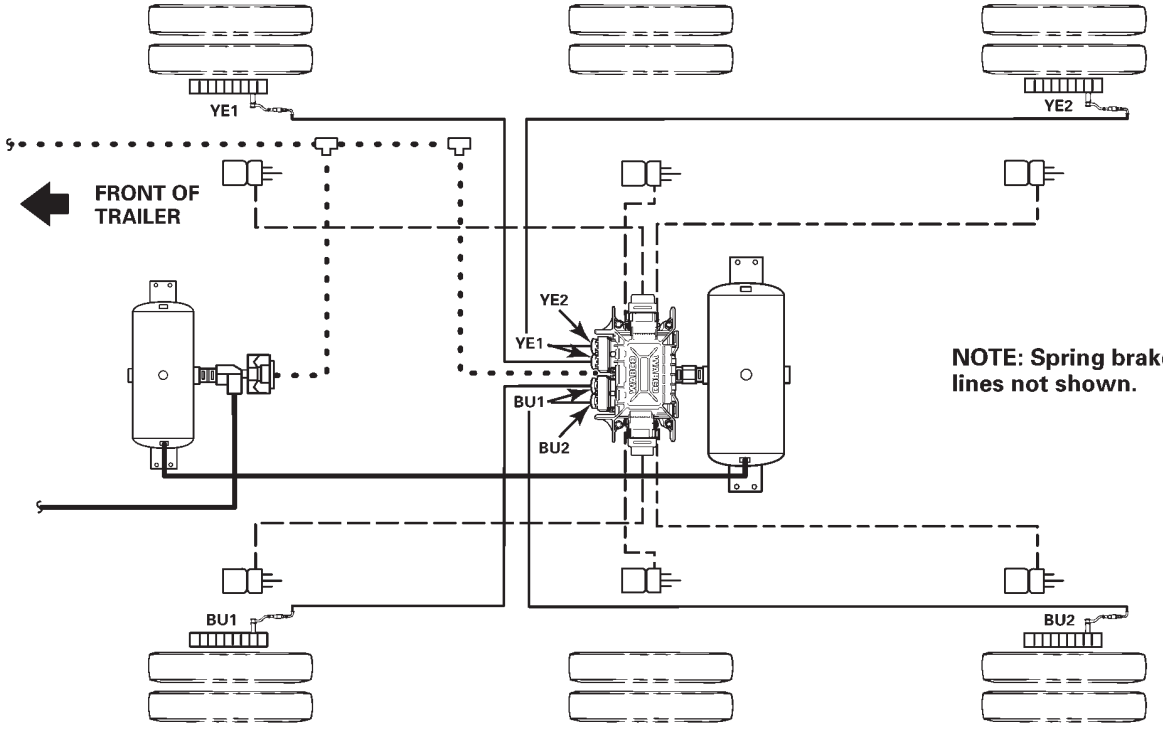


Figure 1-28: 4S/2M Premium Installation

4S/2M PREMIUM — TYPICAL TRI-AXLE — MOUNTED WITH SENSORS FACING FRONT OF TRAILER



4S/2M PREMIUM — TYPICAL TRI-AXLE — MOUNTED WITH SENSORS FACING REAR OF TRAILER

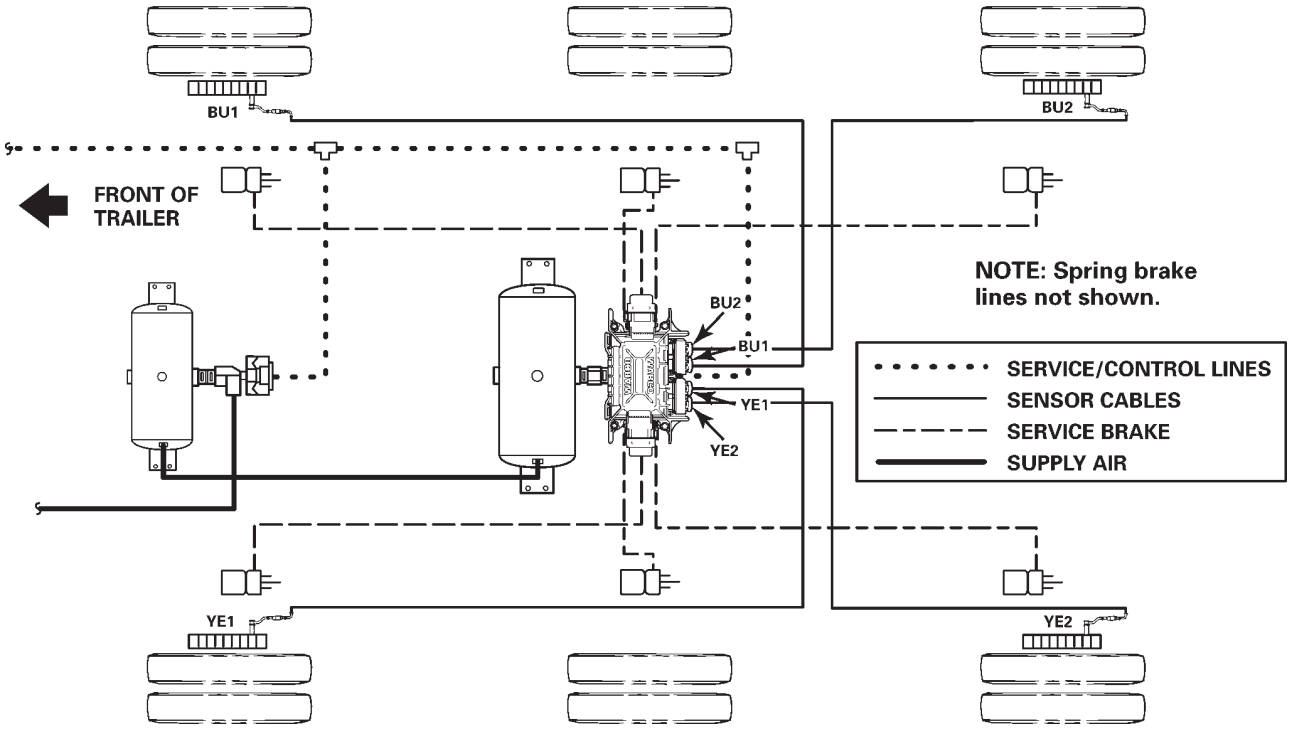
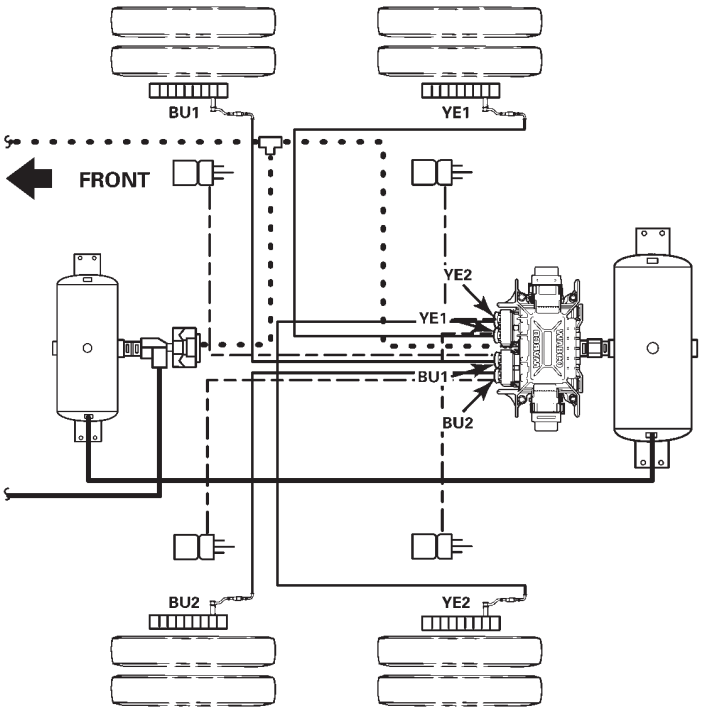


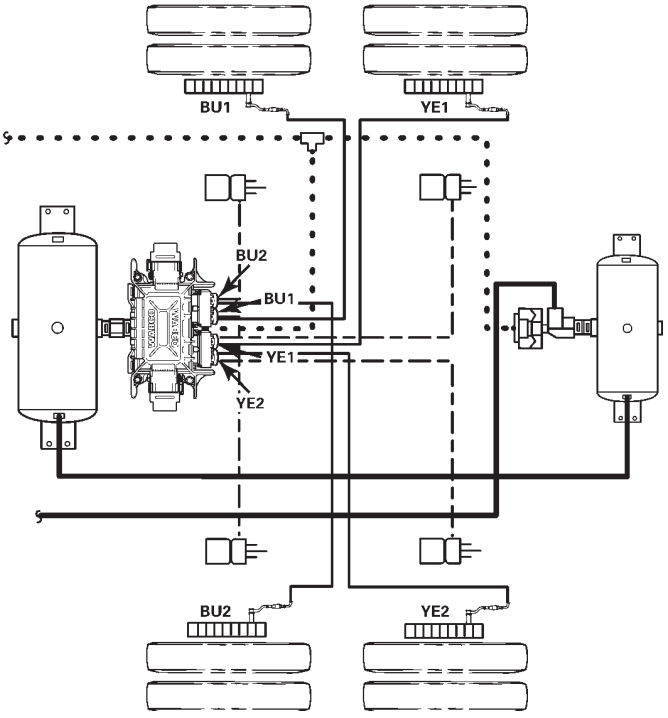
Figure 1-29: 4S/2M Premium Typical Tri-Axle Installation

4S/2M PREMIUM — TYPICAL AXLE CONTROL INSTALLATION — MOUNTED WITH SENSORS FACING FRONT OF TRAILER



NOTE: Spring brake lines not shown.

4S/2M PREMIUM — TYPICAL AXLE CONTROL INSTALLATION — MOUNTED WITH SENSORS FACING REAR OF TRAILER



FRONT

NOTE: Spring brake lines not shown.

SERVICE/CONTROL LINES
SENSOR CABLES
SERVICE BRAKE
SUPPLY AIR

Figure 1-30: 4S/2M Premium Typical Tri-Axle Installation

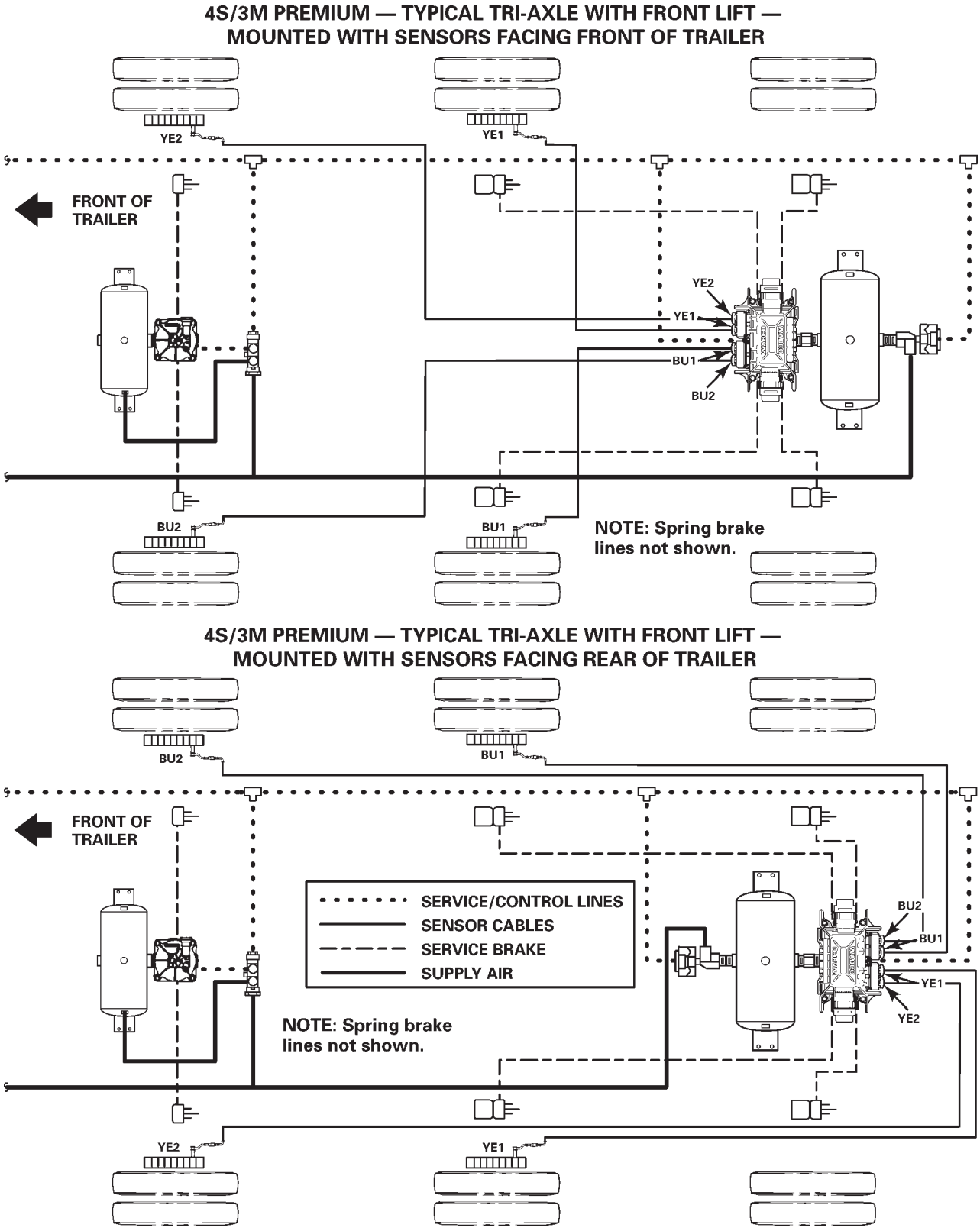


Figure 1-31: 4S/3M Premium Typical Tri-Axle with Front Lift Installation

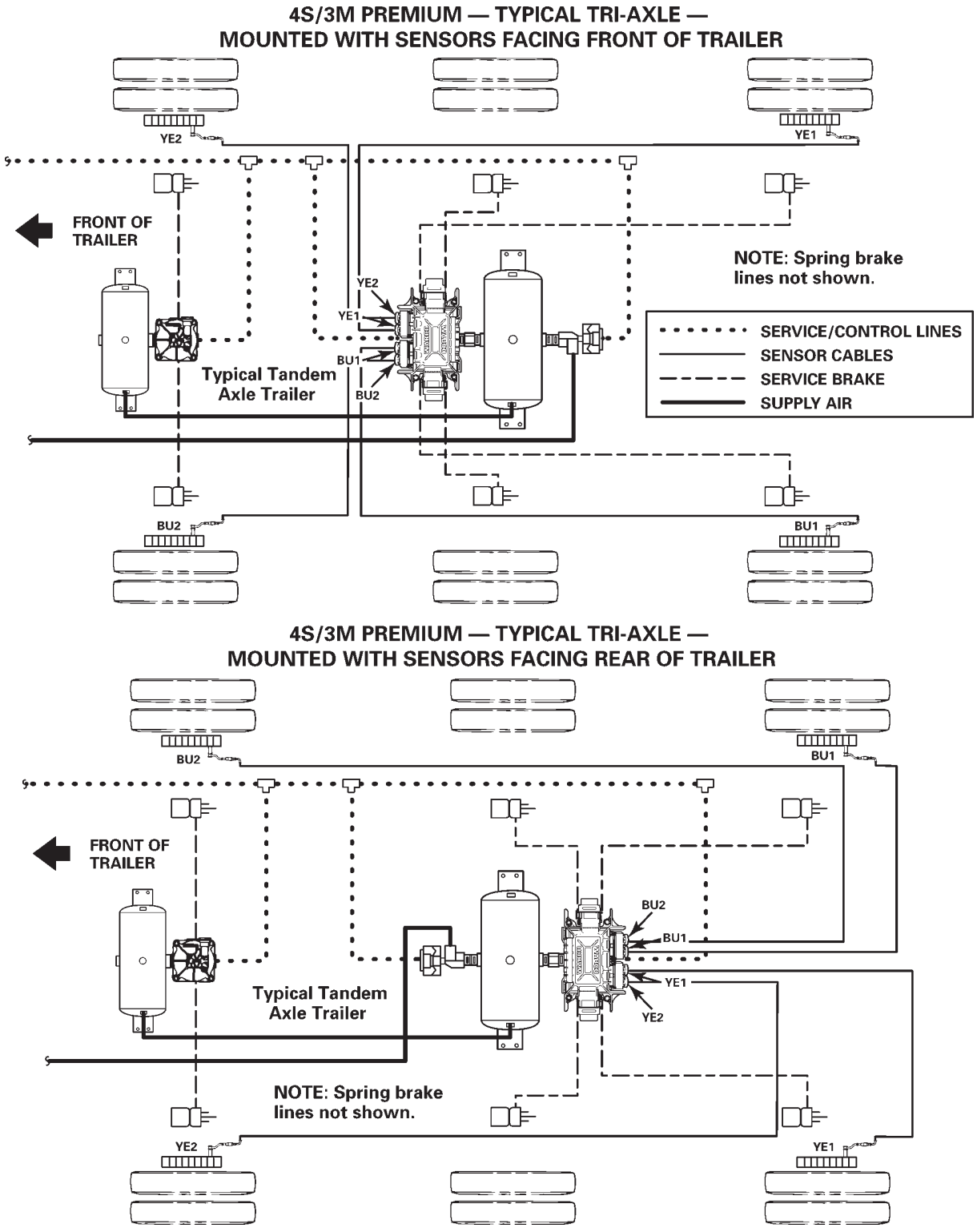


Figure 1-32: 4S/3M Premium Typical Tri-Axle Installation

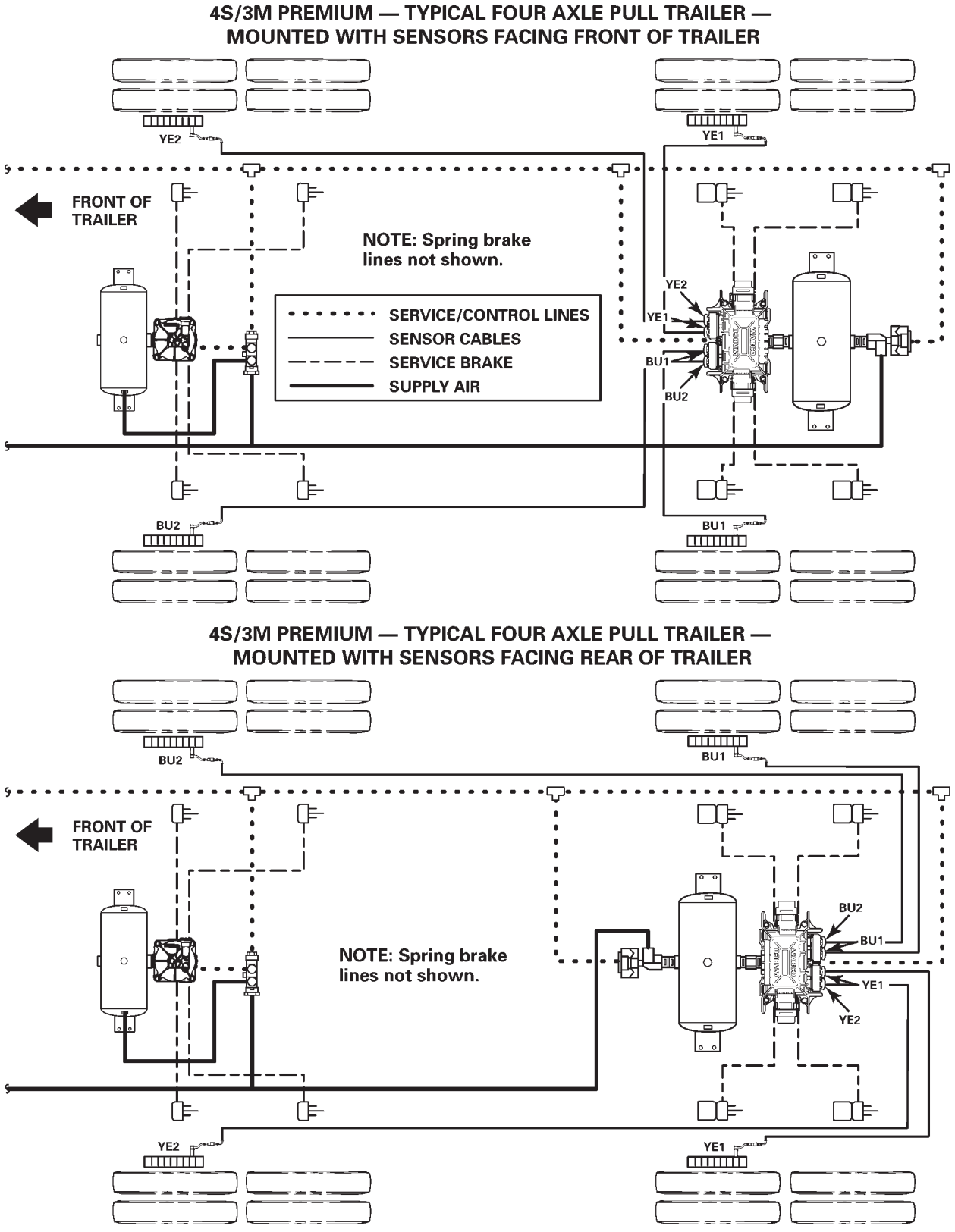


Figure 1-33: 4S/3M Premium Typical Four-Axle Pull Trailer Installation

ECU/Valve Assembly Reconfiguration

When a new ECU/dual modulator valve assembly is installed in a system, it automatically reconfigures itself to that system, based on the number of sensors and ABS modulator valves that are connected to it. If a used ECU/dual modulator valve assembly is installed on a system with fewer sensors or ABS modulator valves, it will have to be reconfigured with TOOLBOX™ Software.

For example, if a 2S/2M Premium ECU/dual modulator valve assembly is installed in a 4S/2M system, no reconfiguration is required since that procedure occurs automatically.

NOTE: The 2S/1M Basic and the 2S/2M Standard ECU configurations cannot be changed (reconfigured).

This module defined Meritor WABCO Enhanced Easy-Stop™ Trailer ABS. It described the system and its theory of operation.

The individual components were introduced and briefly described. Illustrations of the components were included.

- ECU
- Single and dual modulator valve assemblies
- Wheel speed sensors
- Cables

You should have learned the theory and operation of the ECU, modulator valve assembly and wheel speed sensors. You should know and understand how each component affects others.

Descriptions and wiring diagrams were provided for the different cables that are available for this system. You should be familiar with each cable and its use.

- Power cable
- Power/diagnostic cable
- ABS modulator valve cable (4S/3M)
- Generic I/O cable
- ABS modulator valve cable/generic I/O cable

A brief overview was presented on the diagnostic methods available. You should know and understand how to use the diagnostic equipment. There are three ways to gather diagnostic data from Enhanced Easy-Stop™ Trailer ABS systems:

- TOOLBOX™ Software
- Pro-Link 9000
- Blink code diagnostics

This module also described the different configurations of the various Enhanced Easy-Stop™ Trailer ABS components and their general applications (2S/1M, 2S/2M, 4S/2M and 4S/3M).

Please answer the following review questions.

1. Whether the ECU/dual modulator valve assembly is mounted with the sensors facing the front or rear of the trailer determines sensor hook-up.

   True
   False

2. Which component acts as the brains of the system?

   A. Tooth wheel
   B. ABS relay valve
   C. Wheel speed sensor
   D. ECU

3. Which input does the ECU monitor in order to modulate brake action?

   A. Brake pedal
   B. Modulator valve
   C. Wheel speed
   D. Accelerator pedal

4. If the ignition power to the ABS system fails, the ABS will:

   A. Receive power from the stop lamp circuit
   B. Stop functioning
   C. Cause the trailer brakes to fail
   D. Light an indicator on the instrument panel

5. What do the wheel speed sensor and tooth wheel do?

   A. Generate an AC voltage signal
   B. Generate a DC voltage signal
   C. Generate electrical resistance
   D. Charge the ECU

6. The 2S/2M Standard ECU/dual modulator valve assembly has two wheel speed sensors and two:

   A. ABS modulator valves
   B. Solenoids
   C. Delivery ports
   D. ECU controllers

Enhanced Easy-Stop™ with PLC Trailer ABS

STUDENT MANUAL

For MERITOR WABCO Enhanced Easy-Stop™ Trailer ABS ECUs:

P/N 400 500 101 0 2S/IM Basic for Standard Trailers
P/N 400 500 104 0 2S/IM Basic for Dollies, Turntables and Steerables
P/N 400 500 102 0 2S/2M Standard
P/N 400 500 103 0 2S/2M, 4S/2M, or 4S/3M Premium

Module 2
Diagnostics and Repair

MERITOR WABCO

Contents

This module describes the diagnostic procedures for Enhanced Easy-Stop™ Trailer ABS.

The module will also cover the steps for removing and replacing all of the components of Enhanced Easy-Stop™ Trailer ABS and how to test the system before putting a trailer back into service.

After completing this module, you will be able to:

- Diagnose problems in the ABS electrical circuits
- Use TOOLBOX™ Software to diagnose and test Enhanced Easy-Stop™ Trailer ABS
- Read blink codes and retrieve fault information
- Locate all components and connectors
- Remove and replace system components

Diagnostic Tools

There are three methods used to get fault information from the ECU:

- TOOLBOX™ Software
- Pro-Link 9000
- Blink code diagnostics
  - — Ignition power activation
  - — Diagnostic tool

TOOLBOX™ Software

Meritor WABCO TOOLBOX™ Software is a PC-based diagnostic program. Versions 4.1 (or higher) runs in Windows® 95, 98, NT, 2000 or Me and provides diagnostic capabilities by communicating with the ECU. Trailer ABS screens are described in this workbook.

TOOLBOX™ Software:

- Displays both constant and changing information from the ECU being tested
- Displays both active and stored system faults, as well as the appropriate repair instructions
- Activates system components to verify:
  - — System integrity
  - — Proper component operation
  - — Installation wiring

NOTE: A J1587/J1708 to RS232 or PLC to J1708 interface is required to run this software.

Main Screen

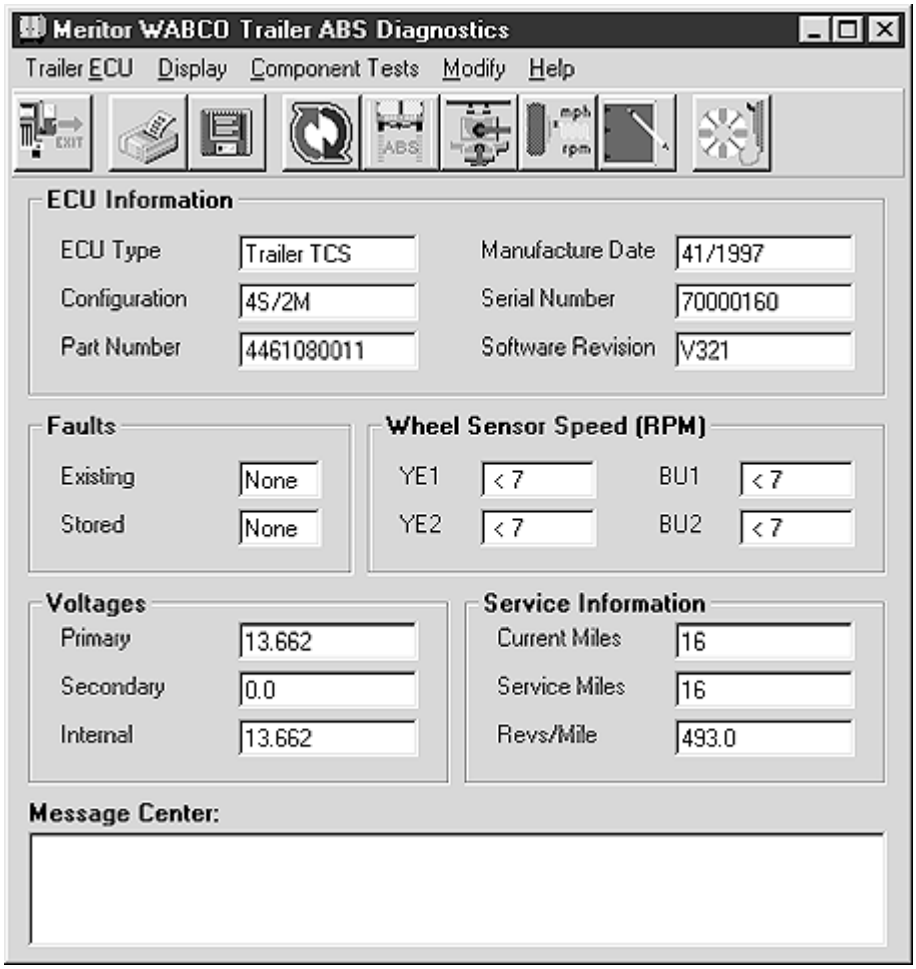


Figure 2-1: Main Screen

This screen provides icon and pull-down menu task selections. It also provides information about the current state of Meritor WABCO Enhanced Easy-Stop™ Trailer ABS. ECU information is read once from the ECU and does not change. Wheel speed, voltages and fault information are read and updated continuously.

Valve Activation

Figure 2-2: Valve Activation Screen

Click on the **Valve Activation** icon to select and cycle individual Enhanced Easy-Stop™ Trailer ABS valves. Listen to ensure the valve is cycling and to verify proper operation, installation and wiring of the Enhanced Easy-Stop™ Trailer ABS system.

Select **All Valves** from the menu to cycle all available Enhanced Easy-Stop™ Trailer ABS valves, starting with yellow.

The ABS indicator lamp on the side of the trailer can be tested to verify a complete circuit. When **Test** is clicked, the lamp will flash eight times. The **Test Status** field will also display the results of this test.

Tire Calibration

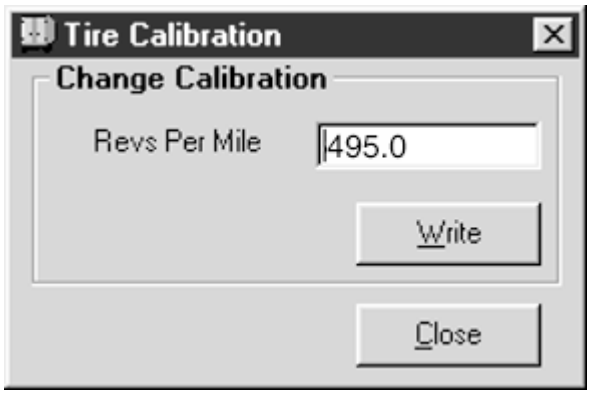


Figure 2-3: Tire Calibration Screen

The programmed number of tire Revs Per Mile is displayed on the **Tire Calibration** screen. The range is 150.0 to 634.0 revolutions per mile. The default value is 502.0. To change this valve, type in the Revs Per Mile, then press the **Write** button.

NOTE: Trailers with 12-1/4-inch brakes use an 80-tooth tone ring (tooth wheel). Use a value of 80 percent of the tire manufacturer's recommended revolutions per mile (revolutions x 0.80).

Service Information

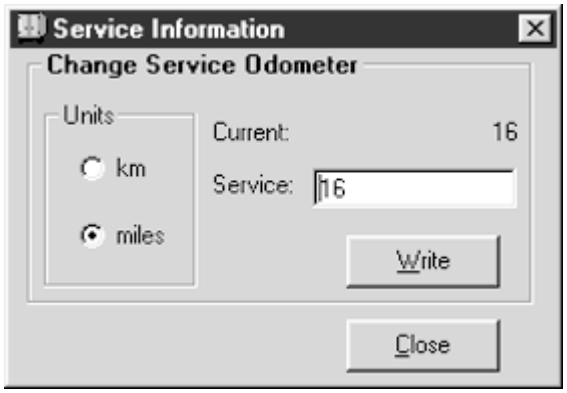


Figure 2-4: Service Information Screen

The mileage between scheduled maintenances is displayed on the **Service Information** screen in km or miles.

When the mileage displayed elapses, the Enhanced Easy-Stop™ Trailer ABS indicator lamp on the side of the trailer will flash eight times. It will continue to flash eight times whenever the ignition switch is turned on until this parameter is changed.

Notebook

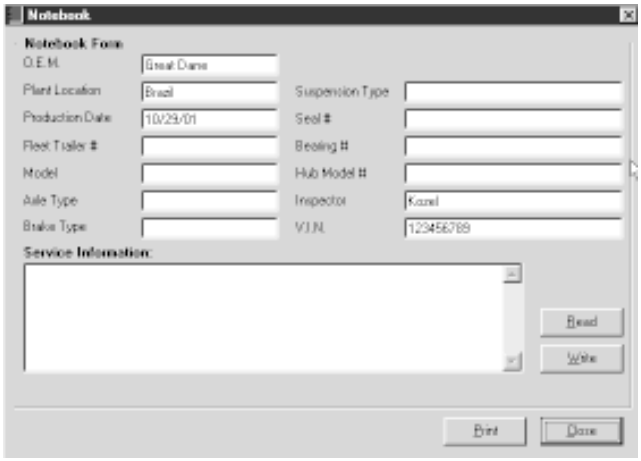


Figure 2-5: Notebook Screen

The **Notebook Form** field of this screen is used to store and review information about a specific vehicle.

The OEM and plant location fields are automatically saved in Notebook once they are entered and saved. To enter this information, use the Modify-Plant Location/OEM Screen.

VIN and inspector information must be saved after entering.

Sensor Test

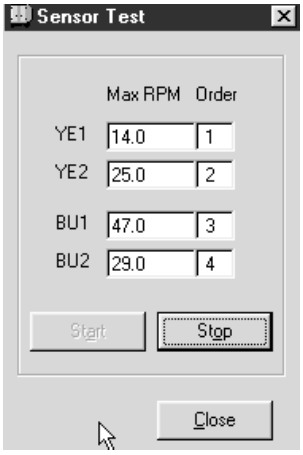


Figure 2-6: Sensor Test Screen

The **Sensor Test** screen is used to determine the correct installation, wiring and functionality of the wheel speed sensors.

The screen display will provide maximum sensor RPM for installed sensors. Unused sensor positions will be grayed out. Check the **Order** field to verify sensors are installed in the correct location.

Sensor Orientation Test

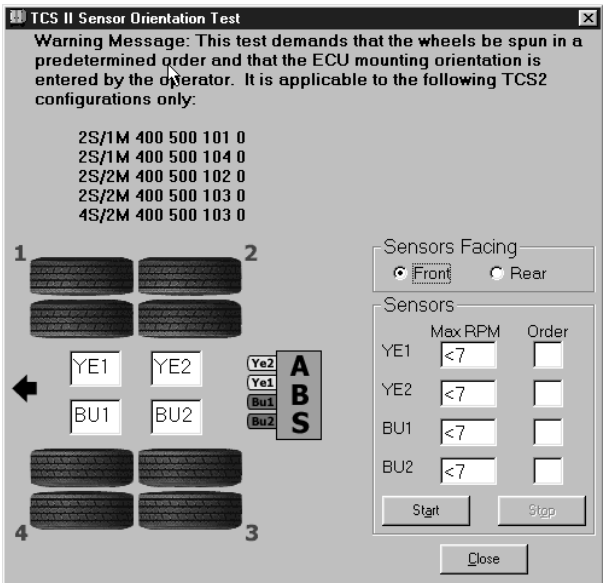


Figure 2-7: Sensor Orientation Test

The **Sensor Orientation Test** provides a simple PASS/FAIL message, letting you know immediately whether or not you have a proper sensor installation.

Report Information

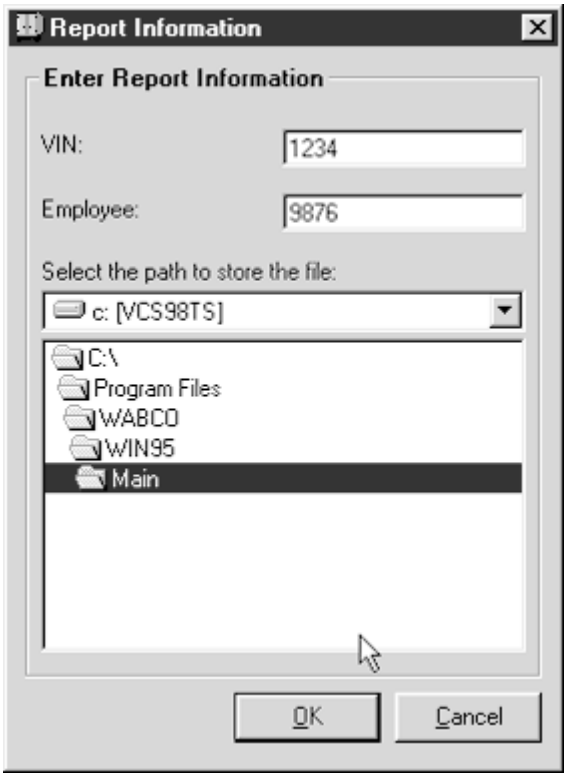


Figure 2-8: Report Information Screen

The **Report Information** screen allows the user to store and retrieve information about a specific vehicle, including the Vehicle Identification Number (VIN) and Employee numbers.

An example of a storable (or printable) report is displayed in Figure 2-9.

To save and print:

1. Click on the heading **Trailer ECU** and click **Save**. A window will appear asking for the VIN and Employee number.
2. Provide this information and close the window.
3. Go back to the heading **Trailer ECU** and click **Print**.
4. You will be asked to input the VIN and Employee number.
5. Click **Print**.

Meritor WABCO ABS Fault Report

Meritor WABCO ABS Fault Report

Date: September 13, 2000
Time: 5:25 PM
Page: 1
VIN: 12345678
Employee Information: KILEY
ABS System Configuration: 4S/2M
ECU Revision: V 3 2 2xxxx
Part Number: 446-108-000-1
Serial Number: 5 9 3 0 3 9 4 8xxxxxxxxx
Date of Manufacture: 13/1999
Current Miles: 0.0
Service Miles: 0.0
Tire Calibration: 495.0

Fault#	Description	Status	SID	FMI	Count
1	Ext. modulator BLUE open circuit detected	Active	9	5	1
2	Ext. modulator BLUE open circuit detected	Stored	9	5	1

Sensor Test Results:

Sensor	Max RPM	Order
YE1	40.0	1
YE2	59.0	2
BU1	50.0	3
BU2	38.0	4

Valve Tests Performed:

Valve	Status (Tested / Not Tested / NA)
Yellow	Tested
Blue	Tested
Red	N/A

Figure 2-9: Meritor WABCO ABS Fault Report

Pro-Link 9000

The Pro-Link 9000 is a diagnostic tool that can be used to troubleshoot Enhanced Easy-Stop™ Trailer ABS. You will need the Multiple Protocol Cartridge (MPC) and a Meritor WABCO applications card, version 2.0 or higher. Refer to the Pro-Link operator's manual for complete instructions.

Blink Code Diagnostics

The Enhanced Easy-Stop™ Trailer ABS ECU detects any electrical fault in the trailer ABS. Each of the faults has a code. When a fault occurs, the ECU stores the code for that fault in the memory.

There are two kinds of faults: active and stored. Active faults are those currently existing in the system, such as a broken wire. Stored faults are faults that have occurred but do not presently exist. Active faults can be cleared only after repairs are completed.

The ECU signals a malfunction by lighting both the internal in-cab and external indicator lamp when a fault exists. The external ABS indicator lamp is usually mounted on the left rear of the trailer, near the rear wheels.

Blink Code Diagnostics (Continued)

Blink codes are flashed from the diagnostic tool LED or by the trailer ABS indicator lamp on the side of the trailer. The blink codes are read by counting the number of times the lamp flashes.

Although the ECU can store multiple faults in its memory, it only displays one blink code at a time. This is why it is important to recheck the blink codes after repairing a fault. If there are additional codes in the memory, they only blink after you have repaired the first fault.

Stored faults, reconfiguration, clear all and final test modes are available with the diagnostic tool.

There are two ways to obtain blink codes:

- Ignition power activation (also called constant power activation)
- Diagnostic tool

Important Information

Blink Code 17 indicates a PLC failure. If PLC does not seem to be operating properly, but there is no Blink Code 17, the ECU is functioning properly and does not need to be replaced; however, there could be a problem in the trailer's wiring harness. Check the wiring system and make the necessary repairs. If the problem persists, contact the Customer Service Center at 800-535-5560 for assistance.

Blink Code Diagnostics (Continued)

Ignition Power Activation

Ignition power activation is the process of using the vehicle's ignition switch (or interrupting the power on the blue wire by some other means) to display blink codes on the trailer ABS indicator lamp located on the side of the trailer. This method is for constant power vehicles only.

To obtain blink codes using ignition power activation, perform the following procedure:

NOTE: For ignition power activation, power is provided by the ignition switch.

1. Turn the ignition switch on for no longer than 5 seconds. The ABS indicator lamp will illuminate.
2. Remove power.
3. Reapply power.
4. The blink code will be displayed three times by the trailer ABS indicator lamp.
5. Find the fault on the following chart.
6. Make the necessary repairs.

Blink Code	Fault Location
3	Sensor BU1
4	Sensor YE1
5	Sensor BU2
6	Sensor YE2
7	External ABS Modulator Valve (Red) 4S/3M only
9	Internal ABS Modulator Inlet Valve #2
10	Internal Modulator Inlet Valve #1
11	Internal Modulator Outlet Valve
14	System Configuration/Power Supply
15	ECU Failure
16	SAE J1708 Failure
17	SAE J2497 (PLC) Failure
18	Generic I/O Failure

Figure 2-10: Blink Code Chart

Blink Code Diagnostics (Continued)

Diagnostic Tool

The red dust cap on the diagnostic tool protects the tool during shipping. The tool and LED are independently sealed against contamination.

The SAE J1587 connector must be protected from contamination when the diagnostic tool is not installed. Reinstall the gray cap when the connector is not in use.

Use the following procedure to install the diagnostic tool in the SAE J1587 connector.

1. Remove the gray protective cap from the J1587 connector. To do this:

   - Turn the cap counterclockwise
   - Pull off the cap

2. Align the notches on the tool with the notches on the connector.
3. Insert the tool firmly in the connector.
4. Firmly turn the gray ring of the tool clockwise to secure it in place.
5. After removing the diagnostic tool, replace the gray protective cap.

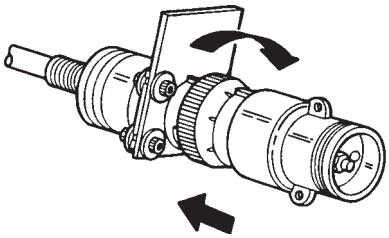


Figure 2-11: Diagnostic Tool Installation

6. Make sure the vehicle is stationary.

   - Emergency brake is on
   - Wheels are properly chocked

7. Provide 12 volts DC power (9.5 to 14 volts is acceptable range) to the ECU/valve assembly.
8. Check the ABS indicator lamp on the trailer. If:

   - The indicator lamp comes on briefly, then goes off, there is no fault in the system
   - The indicator lamp comes on and stays on, there is an existing fault. Go to Step 9

Blink Code Diagnostics (Continued)

9. Press the blink code switch **once** for **one second** and release the switch.
10. **When there is an existing fault,** the ABS indicator lamp will flash between **three** and **eighteen** times to identify the existing fault.
11. **When there are existing faults,** you must repair existing faults.
12. After you identify an existing fault, turn the power to the ECU **off**. Repair the fault. Turn the power to the ECU back **on**.
13. Repeat Step 9. If there are no other existing faults in the system, the ABS indicator lamp will come **on**, go **off** and remain **off**.
14. If you have just repaired a sensor gap fault, the ECU is "waiting" to see a 4-mph signal on sensed wheels. Until this 4 mph is sensed by the ECU, the ABS indicator lamp on the trailer will remain **on**.

Fault Code Check

Use either the blink code tool or the lamp on the side of the trailer to count the number of flashes, but do not use both. The code is displayed on both the trailer ABS indicator lamp and blink code tool, but not in sequence. For example: If the blink code is 4, the lamp will flash once, then the tool will flash once and repeat this until the entire code has been displayed, as illustrated below:

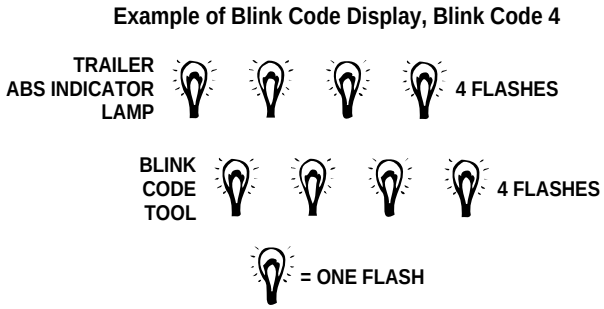


Figure 2-12: Example of Blink Code Display

This section presents general replacement procedures. Do not use it for actual removal and replacement. Use Meritor WABCO installation instructions in Maintenance Manual MM-0180.

Installation instructions for Enhanced Easy-Stop™ are as follows:

2S/IM Basic	TP-20212
2S/2M Standard	TP-20213
4S/2M, 4S/2M and 4S/3M Premium	TP-20214

Wheel Speed Sensor

Removal

Follow the manufacturer's instructions to back off the slack adjuster. Remove the wheel and drum. Use the following procedure to remove a wheel speed sensor.

1. Grasp the sensor, not the cable. Rotate and pull the sensor out of its holder.
2. Pull the spring clip from the sensor holder.
3. Remove the tie wraps attaching the sensor cable to the other components.
4. Disconnect the sensor cable from the extension cable.

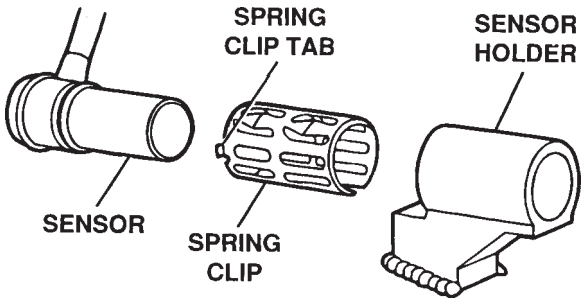


Figure 2-13: Wheel Speed Sensor

Wheel Speed Sensor (Continued)

Installation

Installation requires a lubricant. Use a mineral oil-based grease that contains molydisulfide. The grease must be anti-corrosive and maintain its lubricity throughout the temperature range –40 to 300 degrees Fahrenheit (–40 degrees Celsius to 150 degrees Celsius).

1. Apply a thin coat of lubricant to the spring clip.
2. Push the spring clip into the sensor holder until the tabs touch the holder.

   NOTE: The spring clip must be installed with the tabs on the inboard side of the sensor holder.

3. Apply a thin coat of lubricant to the sensor body.
4. Push the sensor body into the spring clip as far as it will go.
5. Route the sensor cable safely along the axle housing, avoiding interference with the operation of the brakes.
6. Tie wrap the cable to the axle housing about one inch from the cable connector using a tie wrap.
7. Push the sensor body until it contacts the tooth wheel. After installation there should be no gap between the sensor and the tooth wheel.
8. Assemble the drum and wheel on the axle.
9. Check the sensor output voltage. Minimum output must be greater than 0.2 volts AC. See Sensor Output Voltage Test on Page 2-32 of this manual.

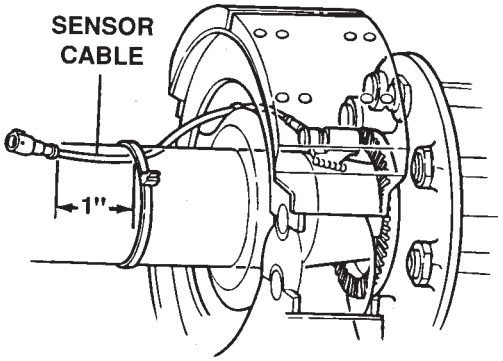


Figure 2-14: Sensor Cable Tie Wrap

ABS Modulator Valve

Removal

⚠ WARNING

Release the air pressure from the brake system before attempting to remove the ABS modulator valve assembly. Pressurized air can cause serious personal injury.

1. Release all pressure from the air system.
2. Disconnect the electrical cable between the ECU/dual modulator valve assembly.
3. Attach identification labels to the air lines for use during installation.
4. Disconnect the air lines from the valve.
5. If the valve is not nipple-mounted directly to the air tank, remove the mounting fasteners.
6. Remove the valve.

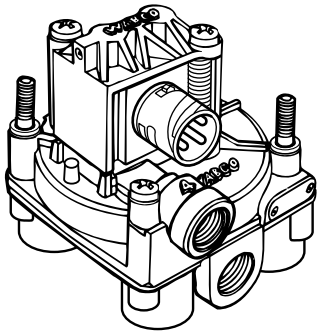


Figure 2-15: ABS Modulator Valve

ABS Modulator Valve (Continued)

Installation

CAUTION

You must use Schedule 80 pipe nipple (3/4-inch NPTF) to nipple-mount the ABS relay valve securely to the reinforced air tank to avoid possible serious personal injury and damage to components.

1. Install the valve with two lock nuts and washers as required. Tighten the hex nuts to a torque of 18 lb-ft (24 N•m) or nipple-mount the valve directly to the air tank with Schedule 80 pipe nipple (3/4-inch NPTF).
2. Connect the air lines to the ports according to the labels installed when the air lines were disconnected.
3. Connect the cable to the valve.
4. Pressurize the brake system. Apply the brakes and verify there are no air leaks.

ECU/Valve Assembly

Removal

⚠ WARNING

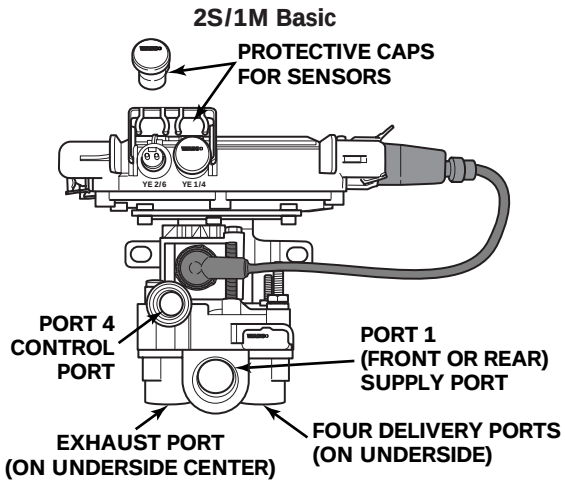
Release all pressure from the air system before you disconnect any components. Pressurized air can cause serious personal injury.

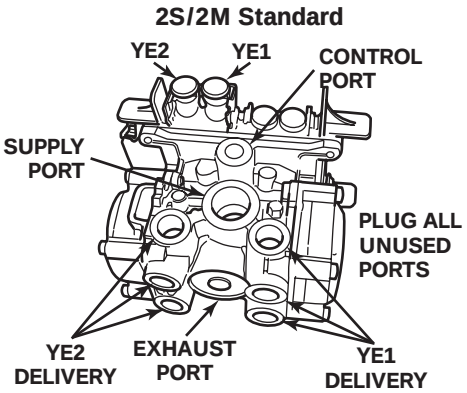
1. Release all pressure from the air system.
2. Attach labels to identify all air lines.
3. Disconnect the air lines from the ECU/valve assembly.
4. Disconnect the power (or power/diagnostic) cable, additional relay valve cable (if used) and all sensor cables from the ECU/valve assembly. See Figure 2-16.
5. Remove the ECU/valve assembly from its mounting location:

    - Bracket-mounted: Loosen and remove the two mounting bolts and lock nuts that hold the assembly to the cross member. Remove the assembly
    - Nipple-mounted to air tank: Unscrew the assembly from the air tank

6. If the assembly being replaced is under warranty, return it to the trailer OEM for replacement.

ECU/Valve Assembly (Continued)





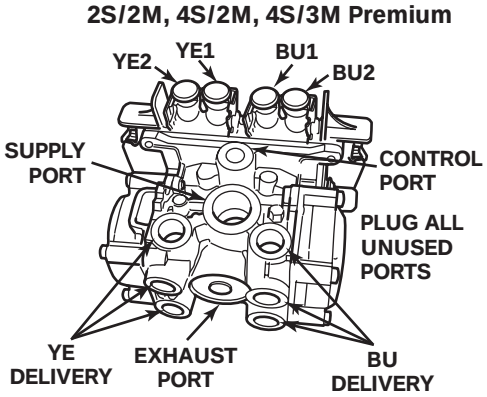


Figure 2-16: ECU/Valve Assembly

ECU/Valve Assembly (Continued)

Installation

NOTE: The ECU/valve assembly is supplied with black protective caps on each sensor connector. When a sensor cable is not plugged into a sensor connector, the black cap must remain on the connector to protect it from dirt and contamination. See Figure 2-16.

⚠ CAUTION

You must use a Schedule 80 pipe nipple (3/4-inch NPTF) to nipple mount the ECU/Valve Assembly securely to the air tank to avoid possible serious personal injury and damage to components.

Tank-Mounted

⚠ WARNING

You must use a Schedule 80 hex nipple (3/4-inch NPTF) to mount the ECU/single modulator valve assembly securely to the air tank to avoid possible serious personal injury and damage to the component.

1. Use a 3/4-inch Schedule 80 hex nipple to attach the ECU/single modulator valve assembly to a reinforced air tank. Do not overtighten.

   NOTE: Meritor WABCO does not recommend use of a vise when installing the hex nipple. Use of a vise may cause overclamping. Overclamping may damage the internal components of the ECU/ single modulator valve assembly.

2. Use a 3/4-inch pipe plug to plug the unused supply port (Port 1). Apply SAE-standard, DOT-approved Teflon tape or paste-type thread sealant to all pipe threads beyond the first two threads. Pipes with pre-applied thread sealant may also be used.
3. Rotate and tighten the ECU/single modulator valve assembly until the exhaust port faces down and the connection is secure. Use a torque wrench or ratchet with extension at the 3/4-inch pipe plug installed on the front supply port (Port 1).
4. Connect the sensor cables, external relay valve cable (if used) and power or power/diagnostic cable to the ECU/dual modulator valve assembly. Use the black protective connector caps included with the replacement assembly to cover unused cable connectors.
5. Perform a final check before returning the trailer to service (see Page 2-35 of this manual).

ECU/Valve Assembly (Continued)

Bracket-Mounted to Cross Member

1. Install a 3/4-inch NPTF fitting in supply port (Port 1). Use a 3/4-inch pipe plug to plug the unused supply port (Port 1).

   - Use a 3/4-inch pipe plug to plug the unused supply port (Port 1). Apply SAE-standard, DOT-approved Teflon tape or paste-type thread sealant to all pipe threads beyond the first two threads. Pipes with pre-applied thread sealant may also be used

2. Attach the mounting bracket to the vehicle cross member midway between the side rails, close to the brake chambers the valve serves.
3. Use two 3/8-inch Grade 8 bolts with prevailing torque nuts and washers to attach the assembly to the vehicle cross member. Tighten bolts to 18 lb-ft (24 N•m).

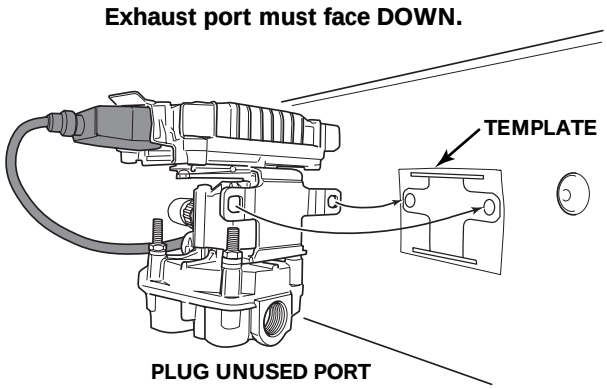


Figure 2-17: Single Modulator Valve Installation

4. Connect the sensor cables, external relay valve cable (if used) and power or power/diagnostic cable to the ECU/dual modulator valve assembly. Use the black protective connector caps included with the replacement assembly to cover unused cable connectors.
5. Perform a final check before returning the trailer to service (see Page 2-35 of this manual).

ECU/Valve Assembly (Continued)

Mounted to Cross Member (Standard and Premium Mounting Brackets Not Supplied by Meritor WABCO)

The ECU/dual modulator valve assemby may be mounted to a bracket or directly to the vehicle cross member. Meritor WABCO does not provide the bracket for the Standard or Premium assemblies. When mounting the ECU/dual modulator valve assembly to the trailer cross member, refer to SAE specification J447, Prevention of Corrosion of Motor Vehicle Body and Chassis Components. Follow all recommendations and procedures. Your supervisor should have a copy of this specification.

1. Install a 3/4-inch NPTF fitting in supply port. Use a 3/4-inch pipe plug to plug unused supply port (Port 1).

    - Apply SAE-standard, DOT-approved Teflon tape or paste-type thread sealant to all pipe plugs beyond the first two threads. Pipes with pre-applied thread sealant may also be used

2. Use two 3/8-inch Grade 8 bolts with prevailing torque nuts to attach assembly. Tighten bolts to 18 lb-ft (24 N•m).
3. Connect the air lines to the ports. Follow the label markers installed when the air lines were disconnected.
4. Connect the sensor cables, external relay valve cable (if used) and power or power/diagnostic cable to the ECU/dual modulator valve assembly. Use the black protective connector caps included with the replacement assembly to cover unused cable connectors.
5. Perform a final check before returning the trailer to service (see Page 2-35 of this manual).

ECU/Valve Assembly (Continued)

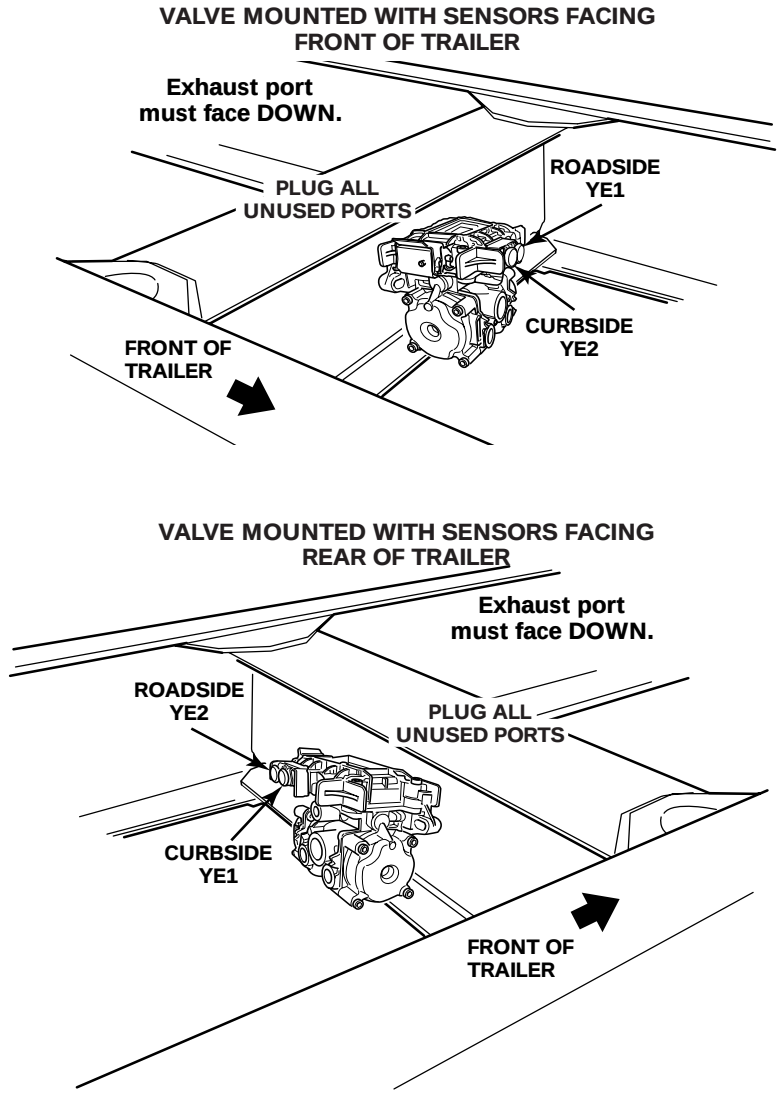


Figure 2-18: 2S/2M Dual Modulator Valve Installation

ECU or Modulator Valve

With Enhanced Easy-Stop™, the ECU and modulator valve may be replaced individually. To do this, follow the instructions for removing the complete assembly, then remove the valve from the ECU.

NOTE: For 2S/1M installations where the valve is readily accessible, it may not be necessary to remove the entire assembly to replace the valve.

NOTE: For 2S/1M bracket-mounted installations, the bracket does not need to be removed to replace the ECU or valve.

2S/1M Basic Only

1. To separate the ECU from the bracket, loosen and remove the three hex nuts from the underside of the bracket. These three hex nuts hold the assembly together.
2. To separate the bracket from the valve, remove the three hex nuts.
3. To attach the ECU to the bracket, tighten the three hex nuts to 6 lb-ft (8 N•m).
4. To attach the valve to the bracket, tighten the three hex nuts to 12 lb-ft (16 N•m).

All Standard and Premium Installations

1. Loosen and remove the four hex nuts holding the assembly together.
2. To attach the valve to the ECU, tighten the four hex nuts to 5 lb-ft (6 N•m).

ECU or Modulator Valve (Continued)

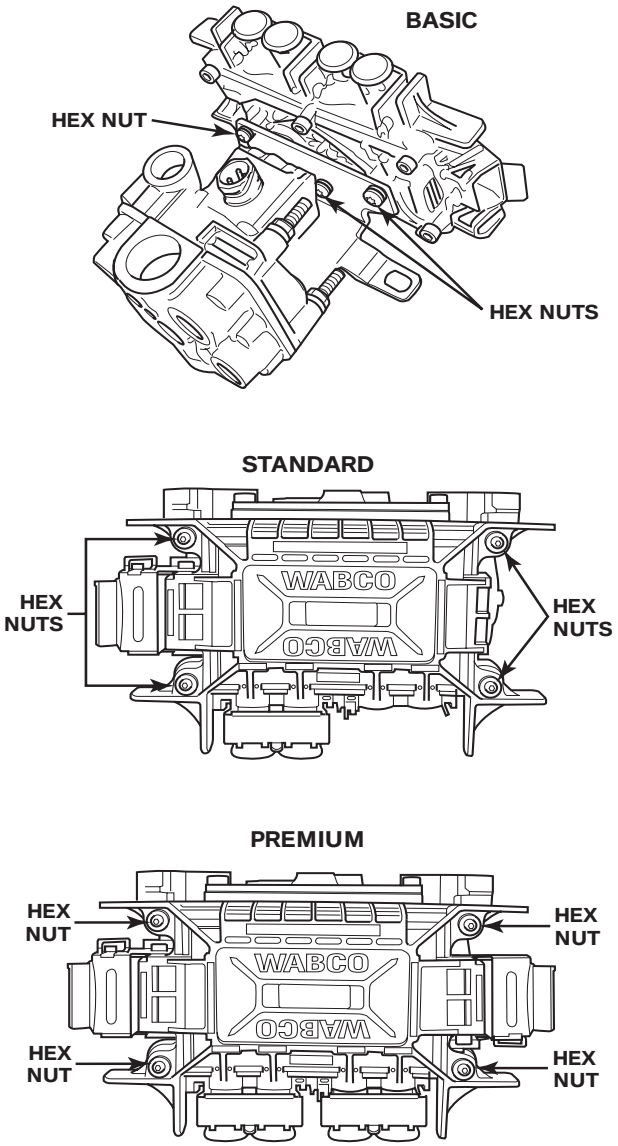


Figure 2-19: Modulator Valve

Wheel Speed Sensors

- At initial installation, no gap must exist between the sensor and the tooth wheel
- After you install a hub, always check that the sensor is adjusted properly

Operating the trailer can cause a gap to develop between the sensor and the tooth wheel. If the gap exceeds 0.040-inch, the system may not function properly.

To adjust the sensor, twist and push the sensor through the sensor bracket as far as possible or until the sensor touches the tooth wheel.

Sensor Test Procedure

1. Disconnect power to the ECU/valve assembly.
2. Disconnect the sensor electrical connector from the ECU/valve assembly.
3. Connect the volt/ohm meter leads to the two wire component terminals inside the disconnected connector.
4. When checking the resistance, the meter must read 900-2000 ohms.
5. Check and replace the sensor and cables as required.
6. Repeat Steps 1 through 5 for each sensor in the system.

Sensor Output Voltage Test

1. Disconnect power from the ECU/valve assembly.
2. Connect the AC volt/ohm meter leads to the sensor terminals inside the connector.
3. Rotate the corresponding wheel at a constant speed of 1/2 revolution per second.
4. The output voltage must be greater than 0.2 volt AC.
5. When there is no reading:

    A. Trace the cable to verify that the cable connects to the wheel you turned.
    B. Check that you turned the correct wheel.
    C. Check that the system is wired correctly.
    D. Check that the sensor touches the tooth wheel.

6. If the volt/ohm meter still indicates no reading or a low reading after following the above procedures, check and replace the component and cables as required.
7. Repeat Steps 1 through 5 for each sensor in the system.

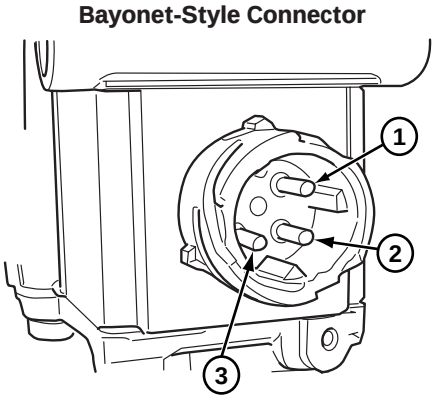
Check ABS Functions

Meritor WABCO recommends that you test a vehicle's ABS after a new installation and after you diagnose, repair and erase faults in the ABS.

- Perform a final check using TOOLBOX™ Software or the Pro-Link 9000

ABS External Modulator Valve

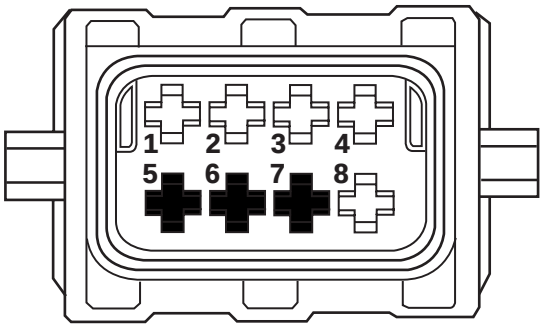
Measure resistance across each valve solenoid coil terminal and ground on the ABS valve to ensure 4.0 to 8.0 ohms. Valve and cable pinouts are illustrated in Figure 2-20.



1. **Exhaust Solenoid**
2. **Inlet Solenoid**
3. **Ground Terminal**

Figure 2-20: Valve and Cable Pinouts

- To check the cable and the ABS valve as one unit, measure resistance across pins 5 and 6 and 5 and 7 on the ECU connector of the harness. Resistance should be between 4.0 and 8.0 ohms for each measurement. See Figure 2-21.



5. **Ground Terminal**
6. **Exhaust Solenoid**
7. **Inlet Solenoid**

Figure 2-21: ECU Connector

- If the resistance is greater than 8.0 ohms, clean the electrical contacts in the solenoid. Check the resistance again.

Final testing is required on all Enhanced Easy-Stop™ Trailer ABS installations. To run these tests, Meritor WABCO recommends you use TOOLBOX™ Software.

TOOLBOX™ Software and general test procedures are included in this manual. If you are using a Pro-Link, refer to the operator's manual for test instructions.

All Installations

NOTE: If you are testing an installation that has a power only cable, temporarily install a Meritor WABCO combination power/diagnostics Y-style cable or use the PLC/J1708 adapter.

1. Connect the diagnostic connector on the cable to the PC serial port/SAE diagnostic interface (J1587/J1708 to RS232 interface).

NOTE: Refer to the TOOLBOX™ Software Owner's Manual, TP-99102, for instructions for running TOOLBOX™ Software.

2. Display the **Trailer ABS Main** Screen.
3. Verify power supply:

   - Apply 12 volts DC to the blue wire (constant). Check the screen for proper voltage (9.5 to 14 volts). Constant power voltage is displayed in the **Primary** field. See Figure 2-22.
   - Apply 12 volts DC to the red wire (stoplight power). Check the screen for proper voltage (9.5 to 14 volts). Stoplight power voltage is displayed in the **Secondary** field. See Figure 2-22.
   - The **Internal** field is not applicable to this test.

4. Check the Faults field on the **Main Screen**:

   NONE = No faults present, proceed with final test.

   YES = Faults present, double-click on "YES" to bring up the fault information screen.

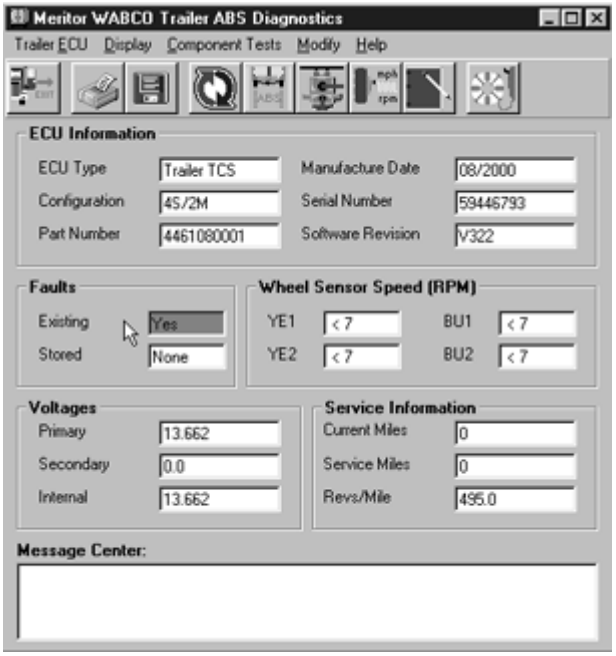


Figure 2-22: Meritor WABCO Trailer ABS Diagnostics Screen

5. Use the information in the **Repair Instructions** field to make the necessary repairs. See Figure 2-23.

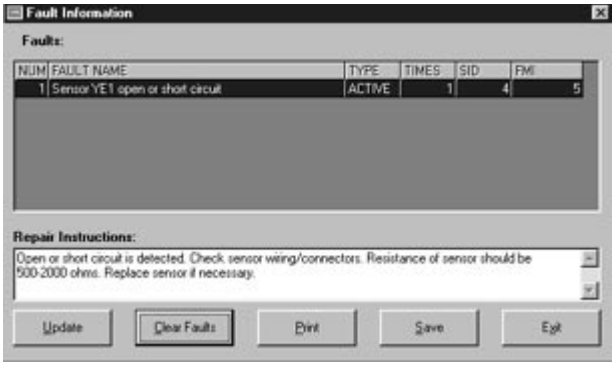


Figure 2-23: Fault Information Screen

Verify Proper Valve and Lamp Installation

2S/1M Basic

To verify valve and lamp installations with TOOLBOX™ Software:

1. At the Trailer **Main Screen** click on **Component Test**, then select **Valves/Lamp** to display the **Valve Activation** Screen. See Figure 2-24.
2. The **Red** valve indicator will be selected. Click on the **Activate** button and listen for the valve to click, indicating a good installation. The **Test Status** box at the bottom of the menu will also display the status of this test.
3. Click on the **Test** button to activate the ABS indicator lamp — this is the lamp that is mounted on the side of the trailer. The lamp will flash eight times, indicating lamp installation is OK. The **Test Status** box at the bottom of the menu will also display the status of this test.
4. Click on **Close** to exit.

Figure 2-24: Valve Activation

2S/2M, 4S/2M, 4S/3M Standard and Premium

To verify valve and lamp installations with TOOLBOX™ Software:

1. Apply 12 volts DC to the ABS.
2. Apply air to the emergency line to fill the air tanks and release the spring brakes.
3. Apply air to the control line.
4. At the **Trailer Main Screen,** click on **Component Test**, then select **Valves/Lamp** to display the **Valve Activation** Screen. The **Yellow** valve indicator will be highlighted. See Figure 2-25.

   NOTE: Selecting All Valves will sequence all of the valves beginning with the Yellow valve.

5. Click on the **Activate** button.
6. Check for proper air line installation. To do this, observe the slack adjusters:

   - If the ECU faces **the front of the trailer**, the slack adjusters will move in and out as the **curbside** portion of the dual modulator valve cycles. If this does not happen, the air lines are not properly connected. Make the necessary repairs
   - If the ECU faces **the rear of the trailer**, the slack adjusters will move in and out as the **roadside** portion of the dual modulator valve cycles. If this does not happen, the air lines are not properly connected. Make the necessary repairs

   NOTE: The Test Status box at the bottom of the menu will display the status of this test.

7. Repeat this test for the **Blue** valve.

   A. Repeat Steps 1 through 3.
   B. Select the **Blue** valve from the valve activation screen.
   C. Click on the activate button to verify proper valve installation (**Blue**).
   D. Check for proper air line installation. To do this, observe the slack adjusters.

      — If the ECU faces **the front of the trailer,** the slack adjusters will move in and out as the **roadside** portion of the dual modulator valve cycles. If this does not happen, the air lines are not properly connected. Make the necessary repairs

— If the ECU faces **the rear of the trailer,** the slack adjusters will move in and out as the **curbside** portion of the dual modulator valve cycles. If this does not happen, the air lines are not properly connected. Make the necessary repairs

8. **For 4S/3M installations:** Repeat this test for the red valve. Red: The external relay valve designated RED (RD) is an axle control valve. It controls brake chambers on one or two axles. It is important that delivery lines from Port 2 are plumbed as shown on the installation drawings. The 4S/3M system is designed to be used with a variety of trailer configurations. Call ArvinMeritor's Customer Service Center at 800-535-5560 for additional information.
9. Click on the **Test** button to activate the ABS indicator lamp — this is the lamp that is mounted on the side of the trailer. The lamp will flash eight times, indicating lamp installation is OK. The **Test Status** box at the bottom of the menu will display the status:

Message	**Status**
Complete	OK
Critical Error	Communication Error (If this message occurs: Check cable connections, recycle power)

10. Click on **Close** to exit.

Figure 2-25: Valve Activation

Sensor Installation Test

Sensor Installation Testing is required for all installations.

To test the sensor installation:

1. Raise both sensed wheel ends off of the ground.
2. Apply air to the emergency line to fill the air tanks and release the spring brakes so that the wheels can be rotated.
3. Apply 12 volts DC to the ABS.
4. At the **Trailer Main Menu,** click on **Component Test,** then select **Sensor Test** to display the **Sensor Test** screen.
5. Click on the **Start** button to start the test.
6. Rotate the sensed wheel ends at a rate of 1/2 revolution per second. This rate equals a wheel speed of approximately 4 mph (7 kph).
7. Check the screen for sensor output. See Figure 2-26.

    - Make sure there is sensor output. If sensor output is displayed, the sensor test is complete
    - If there is no sensor output, verify that a tone ring has been installed and that the sensor is pushed all the way in against the tone ring. Make the necessary repairs and repeat the sensor test. If the problem persists, contact Meritor WABCO

8. Check **Order** fields to verify sensors were installed in the right location based on orientation of the valves or run a sensor orientation test. See Figures 2-26 and 2-27.

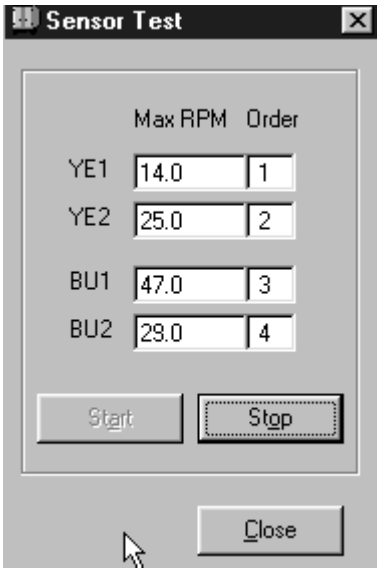


Figure 2-26: Sensor Test

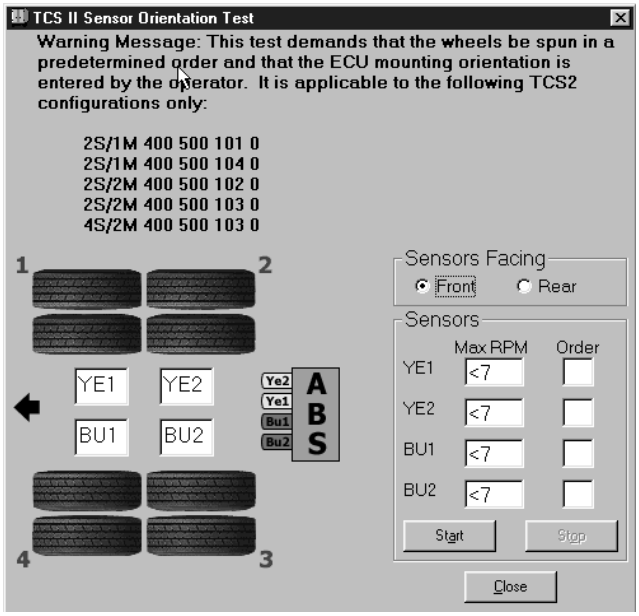


Figure 2-27: Sensor Orientation Test

Final Testing without TOOLBOX™ Software

2S/1M Basic

1. Apply 12 volts DC power to the ABS.
2. The ECU/single modulator valve assembly should click two times.
3. If the indicator lamp **comes on** for three seconds and **goes out:**

   This indicates a proper installation. The final test is complete.

   If the ABS indicator lamp **comes on** and **stays on**, check the sensor installation:

   A. Remove the power from the ABS and raise the sensed wheels so they may be rotated.
   B. Repeat Step 1 and 2.
   C. Rotate each sensed wheel, one at a time, at a rate **less than 25 RPM**.

   The ABS indicator lamp should now go out and stay out indicating a proper installation. The final test is complete.

4. If the ABS lamp does not go out, there is a sensor gap problem or hardware fault. Adjust the sensor and, if necessary, perform a fault code check.

2S/2M Standard Sensor Installation Check

1. Look at the YE2 and YE1 sensor connectors on the ECU/dual modulator valve assembly. Make sure the connectors are routed to the proper wheel end location, as follows:

   - If the ECU/dual modulator valve assembly is mounted with sensors facing the front of the trailer

     — Sensor YE2 must be routed to the curbside wheel end location
     — Sensor YE1 must be routed to the roadside wheel end location

   - If the ECU/dual modulator valve assembly is mounted with sensors facing the rear of the trailer

     — Sensor YE2 must be routed to the roadside wheel end location
     — Sensor YE1 must be routed to the curbside wheel end location

2. If sensors are not properly installed, make the necessary repairs.

2S/2M Air Line Installation Check

1. Make sure all unused air ports are plugged and that the exhaust port is facing DOWN.
2. Look at the air line installation to make sure all air lines are properly installed.

    - If the ECU/dual modulator valve assembly is mounted with the sensors facing the **front** of the trailer, the air lines for the three delivery ports located under the YE2 sensor connector must be routed to **curbside**; the air lines for the three delivery ports on the opposite side of the valve must be routed to roadside. See Figure 2-28.
    - If the ECU/dual modulator valve assembly is mounted with the sensors facing the **rear** of the trailer, the air lines for the three delivery ports located under the YE2 sensor connector must be routed to **roadside**; the air lines for the three delivery ports on the opposite side of the valve must be routed to **curbside**. See Figure 2-29.

3. If air lines are not properly routed, make the necessary repairs.

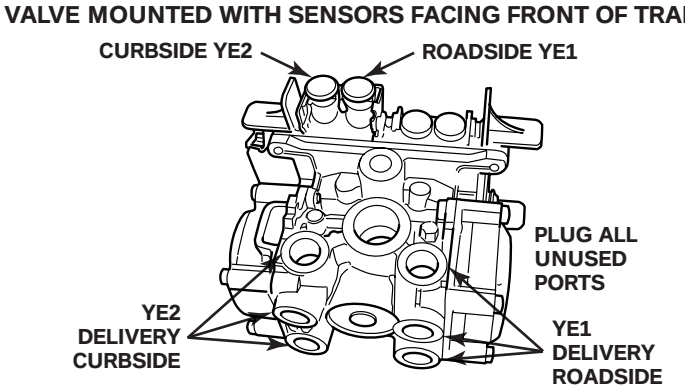


Figure 2-28: Valve Mounted with Sensors Facing Front of Trailer

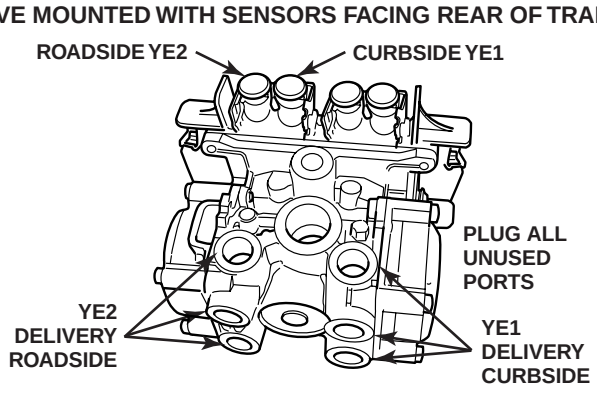


Figure 2-29: Valve Mounted with Sensors Facing Rear of Trailer

2S/2M, 4S/2M and 4S/3M Premium Sensor Installation Check

1. Look at the sensor connectors on the ECU/dual modulator valve assembly. Make sure the connectors are routed to the proper wheel end location, as follows:

   ECU/Dual Modulator Valve Assembly Mounted with Sensors Facing Front of Trailer

   - 2S/2M
     - — Connect curbside sensor at YE1.
     - — Connect roadside sensor at BU1.
   - * 4S/2M
     - — Connect curbside front sensor at YE1.
     - — Connect curbside rear sensor at YE2.
     - — Connect roadside front sensor at BU1.
     - — Connect roadside rear sensor at BU2.
   - * 4S/3M — Sensor locations vary by type of installation. Refer to diagrams for specific sensor locations
     - — Connect curbside sensor at YE1.
     - — Connect curbside sensor at YE2.
     - — Connect roadside sensor at BU1.
     - — Connect roadside sensor at BU2.

   ECU/Dual Modulator Valve Assembly Mounted with Sensors Facing Rear of Trailer

   - 2S/2M
     - — Connect curbside sensor at BU1.
     - — Connect roadside sensor at YE1.
   - * 4S/2M
     - — Connect curbside front sensor at BU1.
     - — Connect curbside rear sensor at BU2.
     - — Connect roadside front sensor at YE1.
     - — Connect roadside rear sensor at YE2.
   - * 4S/3M — Sensor locations vary by type of installation. Refer to diagrams for specific sensor locations
     - — Connect curbside sensor at BU1.
     - — Connect curbside sensor at BU2.
     - — Connect roadside sensor at YE1.
     - — Connect roadside sensor at YE2.

* **If the lift axle is sensed in 4S/2M and 4S/3M installations:** Sensors YE2 and BU2 must always be used on the lift axle to avoid an unwanted ABS indicator lamp illumination.

2. If sensors are not properly installed, make the necessary repairs.

2S/2M, 4S/2M and 42/3M Premium Air Line Installation

1. Make sure all unused air ports are plugged and that the exhaust port is facing DOWN.
2. Look at the air line installation to make sure all air lines are properly installed.

   - If the ECU/dual modulator valve assembly is mounted with the sensors facing the **front** of the trailer, the air lines for the three delivery ports located under the YE sensor connectors must be routed to **curbside**; the air lines for the three delivery ports on the opposite side of the valve must be routed to **roadside**. See Figure 2-30.
   - If the ECU/dual modulator valve assembly is mounted with the sensors facing the **rear** of the trailer, the air lines for the three delivery ports located under the YE sensor connectors must be routed to **roadside**; the air lines for the three delivery ports on the opposite side of the valve must be routed to **curbside**. See Figure 2-31.

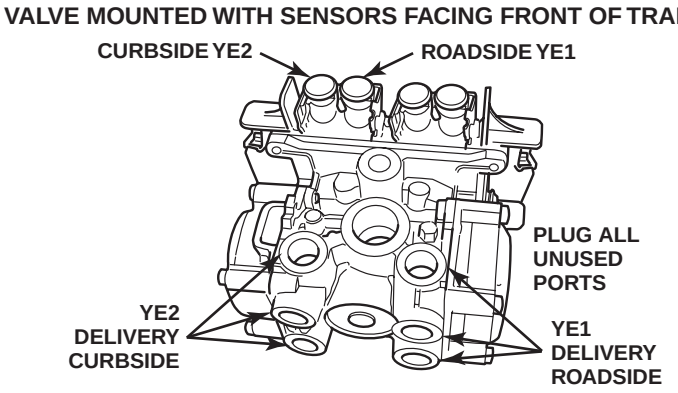


Figure 2-30: Valve Mounted with Sensors Facing Front of Trailer

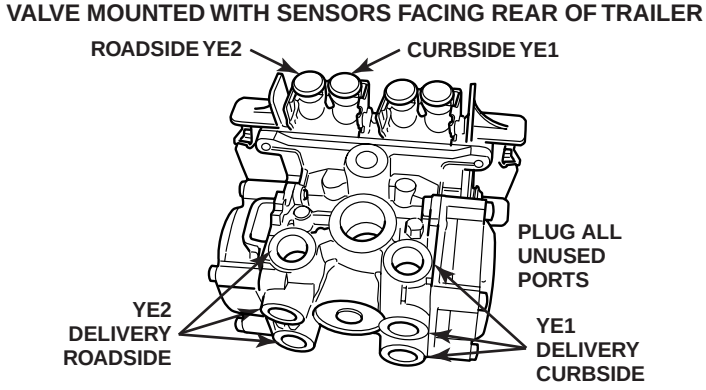


Figure 2-31: Valve Mounted with Sensors Facing Rear of Trailer

3. **For 4S/3M installations:** Repeat this test for the Red valve.

   - Red: The external relay valve designated RED (RD) is an axle control valve. It controls brake chambers on one or two axles. It is important that delivery lines from PORT 2 are plumbed as shown on the installation drawings in Section 1 of this manual. The 4S/3M system is designed to be used with a variety of trailer configurations. Call ArvinMeritor's Customer Service Center at 800-535-5560 for additional information

4. If air lines are not properly routed, make the necessary repairs.

Final Testing (Standard and Premium Installations)

1. Apply 12 volts DC power to the ABS.
2. The ECU/dual modulator valve assembly should click four times (six times for a 4S/3M).
3. If the indicator lamp **comes on** for three seconds then **goes out**, this indicates a proper installation. The final test is complete.

   If the ABS indicator lamp **comes on** and **stays on**, check the sensor installation:

   A. Remove the power from the ABS and raise the sensed wheels so they may be rotated.
   B. Apply emergency air to fill the air tanks and release the spring brakes so that the wheels may be rotated.
   C. Repeat Step 1 and 2.
   D. Rotate each sensed wheel, one at a time, at a rate of **less than 25 RPM**.

   The ABS indicator lamp should now go out and stay out indicating a proper installation. The final test is complete.

4. If the ABS lamp does not go out, there is a sensor gap problem or hardware fault. Adjust the sensor and, if necessary, perform a fault code check.

Sensor Gap Adjustment (All Installations)

1. Push the sensor into its holder until it contacts the tooth wheel. At installation, there must be no gap between the sensor and the tooth wheel.
2. Measure the AC voltage output. Value should be 0.2 volt AC when the wheel is rotated at a rate of 1/2 revolution per second.

Fault Code Check (All Installations)

Use constant power activation to perform the fault code check, as follows:

1. Apply constant power to the ECU/dual modulator valve assembly for more than one, but less than five seconds.
2. Remove power.
3. Reapply power.
4. Check the trailer ABS indicator lamp on the side of the trailer. The fault code will be displayed three times.
5. Find the fault on the table and make the necessary repairs.
6. After making the necessary corrections, repeat the final test.

BLINK CODES		
Blink Code	**Problem Area**	**Action**
3	Sensor BU1	Determine sensor location. Check sensor installation. Make necessary repairs.
4	Sensor YE1	Determine sensor location. Check sensor installation. Make necessary repairs.
5	Sensor BU2	Determine sensor location. Check sensor installation. Make necessary repairs.
6	Sensor YE2	Determine sensor location. Check sensor installation. Make necessary repairs.
7	External ABS modulator valve	Verify proper electrical installation. Check power supply. Make necessary corrections.
9	Internal modulator failure, inlet valve #2	Verify proper installation. If code continues, contact Meritor WABCO for assistance.
10	Internal modulator failure, inlet valve #1	Verify proper installation. If code continues, contact Meritor WABCO for assistance.
11	Internal modulator failure, outlet valve	Verify proper installation. If code continues, contact Meritor WABCO for assistance.
14	Power Supply	Verify proper electrical installation. Check power supply. Make necessary corrections.
15	ECU Failure	Verify proper installation. If code continues, contact Meritor WABCO for assistance.
16	SAE J1708 Failure	Internal failure, contact Meritor WABCO.
17	SAE J2497 (PLC) Failure	Internal failure, contact Meritor WABCO.
18	Generic I/O Failure	Verify proper electrical installation. Check power supply. Make necessary corrections.

Figure 2-32: Blink Codes

Trailer Label

An Enhanced Easy-Stop™ Trailer ABS label is generally affixed to the trailer near the ABS trailer indicator lamp.

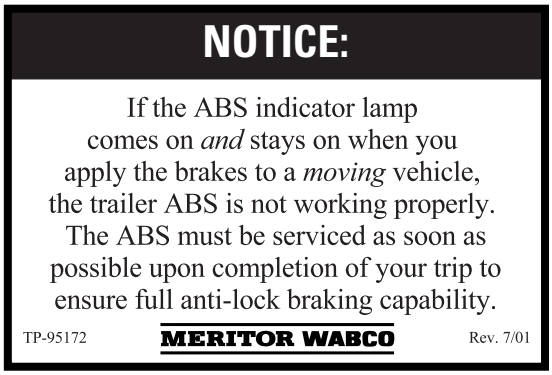


Figure 2-33: Trailer ABS Indicator Label

NOTE: If this label is not included with the assembly, let your supervisor know. Labels are available from Meritor WABCO. Ask for part number TP-95172.

For additional assistance, contact Meritor WABCO at 800-535-5560.

This module described diagnostic procedures for the Enhanced Easy-Stop™ Trailer ABS. In it we discussed the following areas:

- System diagnostics
- Using the proper tool for diagnostics
- Understanding the most to least desirable method of code retrieval
- Reading blink codes and retrieving fault information
- Proper component testing
- Proper component removal and installation
- Clearing memory when repairs are complete
- Testing the installation

The various methods of code retrieval were demonstrated. These methods include TOOLBOX™ Software, Pro-Link 9000, ignition power activation procedure and the diagnostic tool. You have been given blink code information charts and should know how to interpret that information.

You have seen some diagnostic screens used with TOOLBOX™ Software. You should be familiar with these screens and the information they display.

You learned that TOOLBOX™ Software can show constant and changing information, display faults and verify system integrity and wiring.

The roles of active and stored faults and blink codes in diagnostics were demonstrated. Practice on how to use these codes to service a trailer ABS was provided. You should be able to operate the TOOLBOX™ Software, Pro-Link 9000 and be able to retrieve and interpret blink codes using the ignition power activation procedure, or by using the diagnostic tool.

This module explained removal and installation procedures for system components.

Final testing procedures for the Enhanced Easy-Stop™ Trailer ABS were discussed. You should know what to do before placing a trailer back into service.

Please answer the following questions.

1. Another term for ignition power is _____ power.

2. After a visual check, what is the first test you should perform on a sensor?

   A. Road test
   B. Resistance test
   C. Amplitude test
   D. Voltage output test

3. What tool is used to perform a sensor output voltage test?

   A. Ammeter
   B. Pro-Link 9000
   C. Test light
   D. Volt/Ohm meter

4. If the resistance in a sensor is 1200 ohms, what does this mean?

   A. Acceptable resistance
   B. Acceptable voltage
   C. Amplitude out of limits
   D. Resistance out of limits

5. Acceptable sensor output voltage is?

   A. 0 volts
   B. Less than 0.2 AC volts
   C. Less than 0.2 DC volts
   D. Greater than 0.2 AC volts

Please answer the following review questions.

1. Where are the fault codes stored?

   A. Diagnostic tool
   B. Pro-Link 9000
   C. ECU
   D. Diagnostic cable

2. TOOLBOX™ Software is used with:

   A. An extra ECU
   B. A Pro-Link 9000
   C. A personal computer
   D. The ignition power activation procedure

3. The ECU does not detect what types of faults?

   A. Erratic wheel speed
   B. Electrical short circuits
   C. Air line leaks
   D. Electrical open circuits

4. Since March 1, 1998, where is the external trailer ABS indicator lamp located?

   A. At the front of the trailer, visible in the rearview mirror
   B. At the rear of the trailer on the right side near the rear wheels
   C. At the rear of the trailer on the left side near the rear wheels
   D. At the rear of the trailer on the right side near the forward wheels

5. _____ faults and _____ faults are held in memory by the ECU.

6. There are two ways to activate blink codes: _____ and _____.

7. Active faults must be _____ before they can be cleared.

8. Sensor location _____ with suspension type and with ABS configuration.

9. To obtain access to the wheel speed sensor, it may be necessary to _____ the wheel and brake drum.

10. The body of the wheel speed sensor must _____ the tooth wheel at assembly.

11. A sensor gap that occurs during _____, between the tooth wheel and the sensor must not exceed 0.040-inch (19 mm).

12. _____ the air pressure from the brake system before attempting to remove any ABS valve components.

13. The SAE J1587 connector must be protected from _____ when the diagnostic tool is not installed.

14. When testing a wheel speed sensor, measure both the _____ and the _____.

15. Before beginning the final check on a trailer, _____ all blink codes from ECU memory.

ArvinMeritor™
Commercial Vehicle Systems

Meritor WABCO
Vehicle Control Systems
3331 West Big Beaver Road, Suite 300
Troy, MI 48084 USA
800-535-5560
meritorwabco.com

Printed in the USA

TP-0143
Issued 12-01
16579/24240