

Bendix® EC-17™ AntiLock - Traction Controller

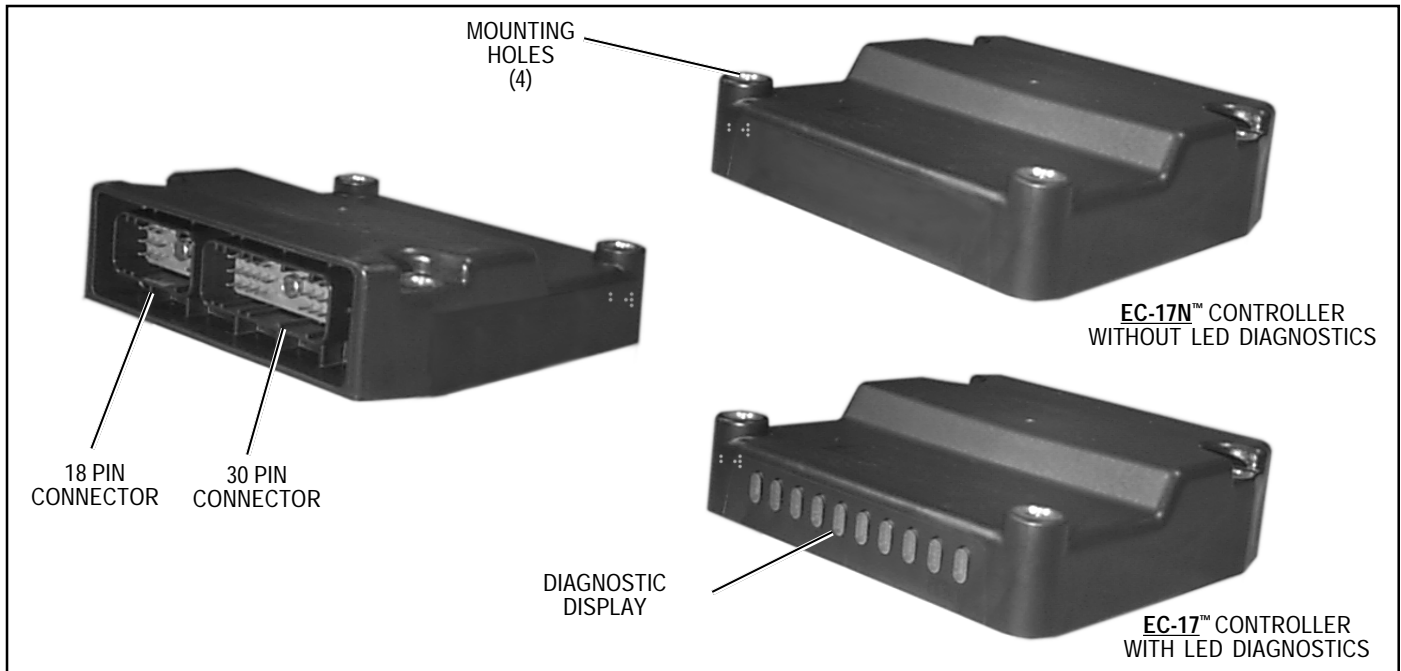


FIGURE 1 - EC-17™ & EC-17N™ ANTILOCK TRACTION CONTROLLERS

DESCRIPTION

GENERAL

The EC-17™ is an electronic antilock controller. It is the base component in a family of full vehicle wheel control antilock systems for buses, trucks and truck tractors. In addition to the antilock function, the EC-17™ controller can be assembled and programmed to provide an optional traction control feature. Figure 1 shows the basic EC-17™/EC-17N™ controller configurations.

Designed to minimize the potential of brake lock up on all wheels during aggressive braking, the EC-17™ controller based antilock system provides the vehicle with a high degree of stability and steerability during braking. In most cases, vehicle stopping distance is also reduced. The antilock portion of the EC-17™ controller based system minimizes wheel skid during hard or aggressive braking. By controlling wheel skid at all wheels on the vehicle, optimum steering control and stopping distance is obtained.

Traction control, an optional feature in the full vehicle wheel control antilock system, helps improve vehicle traction during acceleration in adverse road conditions. Integrated with antilock logic, traction control monitors wheel speed

information from the sensors during acceleration, as well as braking. The system helps maintain vehicle stability on hazardous road surfaces and improves driveability and safety.

The EC-17™ controller contains a self configuring or learning feature that allows it to be configured by the user when installed on the vehicle. Because of this feature, all EC-17™ controllers contain all the features and options available and will activate the specific features required for the vehicle it is installed on. The EC-17™ controller can be installed on vehicles with only antilock or vehicles using the traction control feature. The procedure for activating the self configuring feature is contained in the section entitled "Configuring The EC-17™ Controller".

In order to provide full vehicle wheel control antilock, the EC-17™ controller is used in combination with the following components:

- Four or six wheel speed sensors
- Four air pressure modulator valves
- One dash mounted antilock condition lamp
- One service brake relay valve

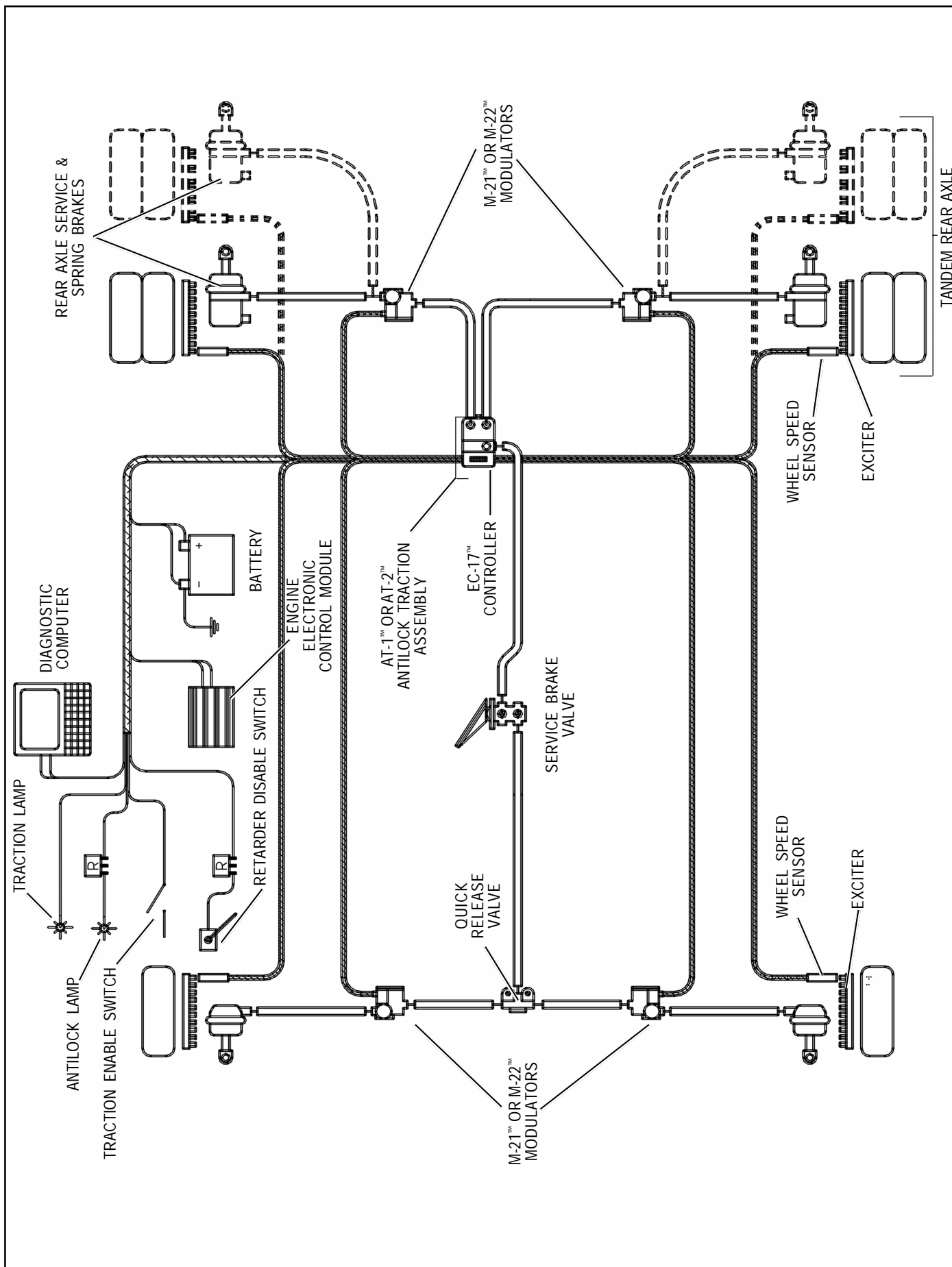


FIGURE 2 - EC-17™ ANTILOCK TRACTION CONTROLLER SYSTEM SCHEMATIC

When programmed to provide traction control in addition to antilock, the following components are added:

- One traction solenoid (incorporated into the relay valve)
- One dash mounted traction condition lamp
- Serial connection to engine control module (for vehicles programmed for torque limiting feature)
- Traction disable wiring and switch

PHYSICAL

The EC-17™ controller electronics are contained in a non-metallic housing and are environmentally protected by an epoxy compound. The design of the digital electronics are intended to provide a high degree of protection from radio, electromagnetic and environmental interference.

The patented optional light emitting diode (LED) display and magnetically actuated reset switch is incorporated in the housing for troubleshooting and diagnostic purposes.

Two electrical connectors, located in the controller housing opposite the diagnostic display (if so equipped), connect the EC-17™ controller to antilock and traction system components: one 30 pin and one 18 pin connector. The optional traction solenoid is linked to the 18 pin connector using a 2 pin Deutsch connector. The optional traction solenoid is located in the upper portion of the antilock traction relay valve assembly. (See Figure 3.)

MOUNTING

The EC-17™ controller is available in two different mounting styles. One model, shown in Figure 1, is a stand-alone. It is intended for bracket mounting to a frame member and is not attached to an antilock relay valve.

The other EC-17™ controller is designed to be mounted on one of four different valves. All of the valves provide the relay

function and replace the standard service relay on antilock equipped vehicles. In some instances the valves also provide specialized functions. When the EC-17™ controller is mounted on any of these valves, the result is a final assembly with its own model designation. Refer to the chart below and Figure 3.

AntiLock Valve	Added Function Provided	Vehicle Application	Designation (Valve + EC-17™ Controller)
AR-1™	None	All	CR-17™ Controller Relay
AR-2™	Bobtail Brake Proportioning	Tractors Only	CR-18™ Controller Relay
ATR-1™	Traction	All	AT-1™ AntiLock Traction
ATR-2™	Traction & Bobtail Brake Proportioning	Tractors Only	AT-2™ AntiLock Traction

EC-17™ CONTROLLER INFORMATIONAL INPUTS AND COMMAND OUTPUTS

GENERAL

The EC-17™ controller receives information from several components in the antilock system and, based on these inputs, issues commands or delivers information. Some portions of the EC-17™ controller both receive and deliver commands and information. (See Figure 5.)

INPUTS

- **Wheel speed** information is provided to the EC-17™ controller via a wiring harness from individual wheel speed sensors at the vehicle wheels (See Figure 4). Working with an exciter or tone ring, wheel speed sensors provide information to the EC-17™ controller in the form of an AC signal which varies in voltage and frequency as the speed of the wheel increases or decreases. The EC-17™ controller is designed to receive wheel speed information, from various wheel speed sensor models, at the rate of 100 pulses (86 pulses if so configured) per wheel revolution. The EC-17™ controller is able to simultaneously receive, and individually interpret, speed signals from up to six wheel speed sensors. Vehicle drive configuration and whether the traction control feature is in use determines the number of speed sensors that must be used. A vehicle with a single rear axle drive (4 x 2, 4 x 4 or 6 x 2) requires 4 speed sensors for both antilock and traction operation. A vehicle with two rear drive

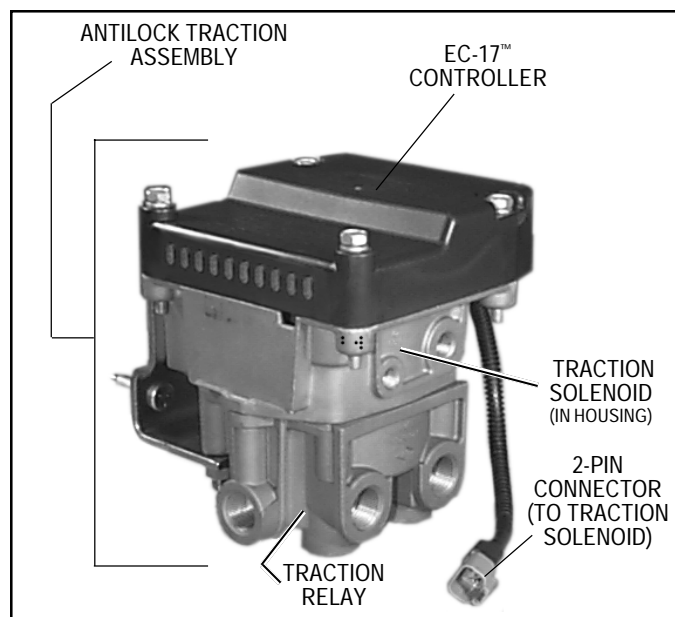


FIGURE 3 - EC-17™ CONTROLLER W/ANTILOCK TRACTION RELAY VALVE

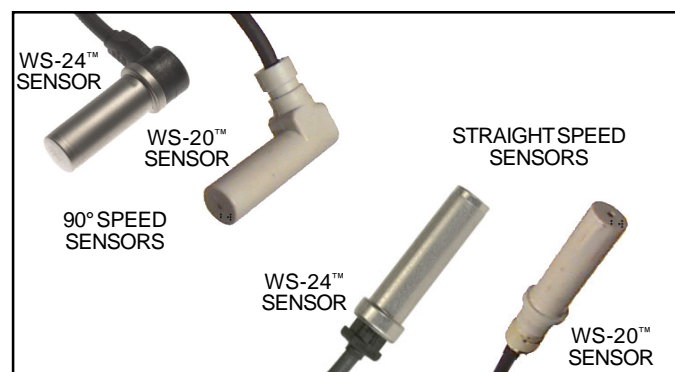


FIGURE 4 - WS-20™ AND WS-24™ WHEEL SPEED SENSORS

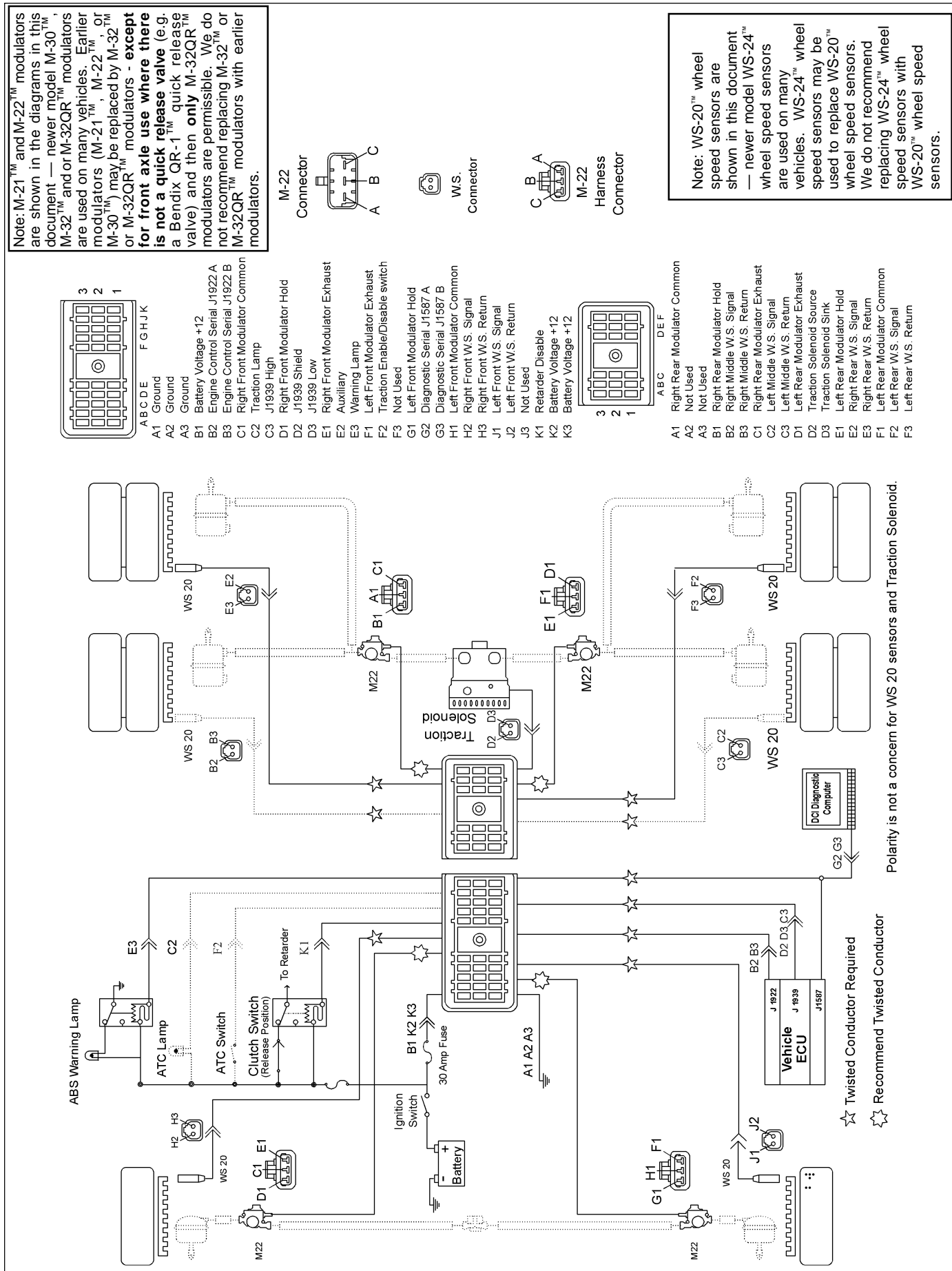


FIGURE 5 - EC-17™ ANTILOCK TRACTION CONTROLLER SYSTEM WIRING SCHEMATIC

axles (6 x 4) requires 4 speed sensors for antilock only operation, but have the option to use 6 speed sensors for enhanced performance of both antilock and traction operation.

- **Vehicle power** is supplied to the EC-17™ controller from the ignition switch through a 30 amp fuse. The electrical ground for the EC-17™ controller is the vehicle chassis.
- A connection for a **traction enable switch** is provided, and used when the optional traction feature is installed. The switch allows traction to be turned on or off manually.
- ATC requires J1922/J1939 drivers requested torque. This input is necessary to engage differential braking on units built after mid-year 2000.

OUTPUTS

- **Modulators** - The Bendix® M-22™ modulator, is the means by which the EC-17™ controller modifies driver applied air pressure to the service brakes. The modulator is an electrically controlled air valve located near the service actuator(s) it controls. It is the last valve that air passes through on its way to the brake actuator. A wiring harness connects the modulator to the EC-17™ antilock controller. Solenoid valves contained in the modulator provide the electrical interface between the EC-17™ controller electronics and the air brake system. The EC-17™ controller is able to simultaneously and independently control four individual modulator assemblies. When vehicle power is supplied to the EC-17™ controller, a modulator “chuff” test is performed. When the brake pedal is depressed and the ECU is powered via the ignition switch, the patented modulator “Chuff” test is audible. A properly wired modulator will exhaust air with a sharp (or crisp) audible “Chuff”. On ECU’s manufactured prior to mid-year 2000, the hold solenoid of a modulator is energized three times longer than an exhaust solenoid while the “Chuff” test is being executed. If the modulator hold and exhaust solenoid wires are reversed the audible “Chuff” is not crisp because of the extended exhaust energization. After mid-year 2000, the hold solenoid of the modulator is energized twice while the exhaust solenoid is energized once. If the modulator hold and exhaust solenoid wires are reversed the modulator will exhaust twice during a “Chuff”. The vehicle modulators will “Chuff” in the sequence: right front, left front, right rear, left rear. It will execute this exhaust sequence twice, for a total of eight exhausts. Both patented audible “Chuff” tests help the mechanic verify when the modulators are functional and connected correctly without needing additional test equipment. If an issue is detected with the modulators, proceed with modulator troubleshooting or compare the modulator wiring to the vehicle wiring schematic found in Figure 5.

- An **AntiLock dash light** through an electrical relay is connected to, and controlled by, the EC-17™ controller and serves as a means of advising the driver of the condition of the antilock system.

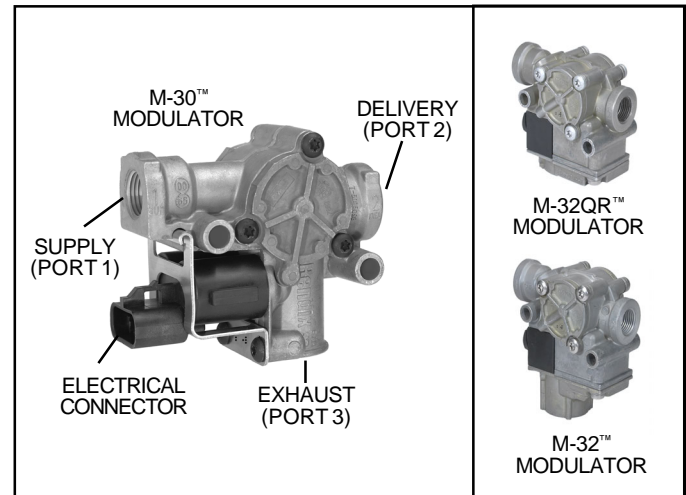


FIGURE 6 - M-30™, M-32™, AND M-32QR™ MODULATORS

- Two **control link** connections to the engine or transmission **retarder** and its relay are provided on the EC-17™ controller. One control link or the other can be utilized, but not both on the same vehicle. The hardware for one control link conforms to S.A.E. standard 1708 and the protocol, or coded language used, conforms to S.A.E. standard J1922. The other control link conforms to S.A.E. standard J1939. Use of a control link allows the EC-17™ controller to temporarily disable the retarder during certain modes of operation. Units built after mid-year 2000 have improved retarder operation, allowing the retarder to re-enable sooner following an ABS event. While the EC-17™ controller is capable of this function, and connections are provided, it is not always used. Use of the retarder disable function is not essential but highly recommended for vehicles equipped with a retarder.

Note: The EC-17™ controller can also disable the retarder using the same S.A.E. J1922 or S.A.E. J1939 protocol it uses to control the traction control, engine torque limiting feature. For this redundant retarder disable to function, the EC-17™ controller must be connected to the engine control module (as would be the case if the EC-17™ controller is programmed for the traction control, torque limiting feature).

- The **diagnostic link** enables the EC-17™ controller to "report" its operating condition to an external computer using the Bendix diagnostic communications interface hardware in response to certain commands it receives from software like Bendix ACom® for Windows*. The EC-17™ controller diagnostic link hardware conforms to S.A.E. standard J1708. The protocol, or coded language used, conforms to S.A.E. standard J1587. While connections are provided for this function, it is not always used. The use of the diagnostic link is essential for the servicing and reconfiguration of the EC-17N™ controller. **The diagnostic link is also used by the EC-17™ controller to request additional information and to assist diagnostics and troubleshooting.**

* Windows is a registered trademark of Microsoft Corporation.

If the EC-17™ controller is programmed for traction control, it contains the following outputs:

- A connection to the **engine's electronic control module** allows the EC-17™ controller to reduce engine torque under certain circumstances.
- A **traction dash light** is connected to and controlled by the EC-17™ controller and serves as a means of advising the driver of the condition of the traction control system.
- A connection to the **traction solenoid** (located in the upper portion of the antilock traction relay valve (see Figure 3) is provided via a 2 pin Deutsch connector.

OPERATION - ANTILOCK (ABS)

PHILOSOPHY

The Bendix® EC-17™ antilock system uses individual sensors, modulators and an electronic controller to control the four vehicle wheel ends. By monitoring the deceleration rate during braking, and subsequently adjusting the brake application pressure at each wheel, the EC-17™ controller is able to improve braking between the vehicle tire and the road surface it is on, while maintaining vehicle stability.

The rear axle brakes are controlled independently; therefore brake application pressure at an individual wheel is adjusted solely on the basis of its behavior on the road surface on which it is traveling.

While each steering axle brake is under the control of an individual modulator, the EC-17™ controller does not treat these brakes independently. The EC-17™ controller uses a modified individual control philosophy for the steering axle brakes. This is done in order to minimize "steering wheel pull" in the event each wheel is traveling on a different road surface (for example, ice close to the curb and a dry crown). Essentially the EC-17™ controller controls the braking force differences between the two brakes.

The wheel on dry pavement is initially given less braking force and is brought up to optimum during the stop, while the wheel on ice attempts to maintain optimum braking during the entire stop.

In the case of vehicles equipped with tandem rear axles (6x2, 6x4), the wheel speed sensors are installed at the wheels on the axle that is most likely to lock first. A single modulator controls both curb side brakes on the tandem, and another modulator controls both brakes on the driver's side of the tandem. With this arrangement of speed sensors and modulators, both brakes on one side of the tandem are treated as one since they will most likely be on the same type of road surface.

NON ANTILOCK BRAKE APPLICATION

During normal braking, air pressure from the brake valve enters the control port of the service relay valve. The service relay delivers air to, and through, the antilock modulator located near the braked wheel, and into the brake actuator. The service brakes are thus applied. If the wheel sensors do not detect an impending wheel lock up, the EC-17™ controller does not initiate any corrective action and the vehicle comes to a stop in a normal fashion.

ANTILOCK BRAKE APPLICATION

If a service brake application is made and the wheel speed sensors detect an impending wheel lockup, the EC-17™ controller will immediately begin modification of the brake application using the antilock modulator(s) at the affected wheel(s). Solenoid valves contained in the modulator (hold and exhaust) are energized and de-energized by the EC-17™ controller in order to modify the brake application. When a solenoid coil is energized, its shuttle moves. Depending upon the function of the specific solenoid, it either opens or closes, thereby causing the exhaust or reapplication of air pressure to the brake actuator. The solenoids in each modulator are controlled independently by the EC-17™ controller. By opening and closing the solenoid valves in the appropriate modulator, the EC-17™ controller is actually simulating what drivers do when they "pump the brakes". It must be remembered however that unlike the driver, the EC-17™ controller is able to "pump" each brake on the vehicle independently and with far greater speed and accuracy.

OPERATION - TRACTION CONTROL (ATC)

PHILOSOPHY

Traction control is a natural extension of antilock. Just as antilock helps vehicle control and stability during braking, traction control helps during vehicle acceleration. The wheel speed sensors not only detect rapid decreases in wheel speed for antilock but also detect unreasonably high increases for traction control. With traction control, a spinning wheel is instantly detected and compared with the other wheels on the vehicle, both front and rear. Two methods are used to control wheel spin, torque limiting and differential braking. Both methods could be configured within the ECU independently or together. On units manufactured after mid-year 2000, only torque limiting can be configured independently. On units manufactured after mid-year 2000 it will also be necessary that the J1922 or J1939 serial link protocol communicate the vehicle throttle position or the ATC will not function.

With traction control, a spinning wheel is instantly detected and compared with the other wheels on the vehicle, both front and rear. Two different methods are used to control wheel spin; torque limiting and differential braking. Depending upon vehicle type, speed and road (surface) condition, each

method provides a unique and desirable type of wheel spin control. Ideally both methods are used to control vehicle traction. While all EC-17™ controllers are capable of providing wheel control antilock and traction control (utilizing both methods of control), not all systems will be configured for both methods. Depending upon the vehicle, either or both traction control methods will be activated during the self configuration procedure.

Torque Limiting - In order for the torque limiting control feature to be used, the vehicle must be equipped with an electronically controlled engine throttle. The torque limiting feature allows the EC-17™ controller to reduce engine torque to a suitable level for the available traction. Torque limiting helps to minimize the amount (or speed) of wheel spin. It is especially useful in helping to minimizing a power jackknife and when all drive wheels are on an equally slippery surface.

Differential Braking - In order for the differential braking control to be used, the vehicle must be equipped with an antilock traction relay valve such as the Bendix® ATR-1™ or ATR-2™. Additionally after mid-year 2000 the ECU requires J1922/J1939 drivers torque request. The ATR-1™ and ATR-2™ relay valves contain a solenoid assembly which provides this feature. The differential braking feature allows the EC-17™ controller to gently pump the brake on the spinning wheel. Since the vehicle's differential tends to drive the wheel that presents the least resistance (the wheel on the most slippery surface), a slight brake application to this wheel only, forces the differential to drive the stationary or slowly spinning wheel. Differential braking can be activated only when vehicle speed is under 25 MPH and one drive wheel is spinning faster than the other(s).

Traction Enable/Disable Switch - The traction control enable/disable switch allows the operator to engage or disengage the traction control system as necessary. The switch may be used to either engage or disengage the traction control system while the vehicle is in motion. It must be noted however that while the traction control will disengage while the vehicle is in motion it will not re-engage (even with the switch in the engaged position) until the vehicle comes to a complete stop.

TRACTION CONTROL AT VEHICLE SPEEDS OF 0 TO 25 MPH

When wheel spin is detected and the vehicle is stopped, or moving at any speed up to 25 mph, the EC-17™ controller simultaneously executes the following operations:

It instantly blinks the traction dash lamp to advise the driver that a wheel spin is occurring.

If the torque limiting feature is active, the EC-17™ controller uses its link to the engine control module and sends a signal to reduce engine torque to a level suitable for the available traction.

If the differential braking feature is configured into the system, the EC-17™ controller energizes the solenoid in the ATR valve which then applies air to each of the rear axle

modulators. Because the modulators are controlled by the EC-17™ controller, the solenoid valves in the appropriate modulator are opened and closed to gently pump the brake on the spinning wheel only. This gentle brake application forces the differential to drive the stationary or slowly spinning wheel.

Once wheel spin is eliminated, the dash lamp goes out and the traction system disengages control.

In the event that extended periods of traction operation are experienced, without vehicle motion being detected, the ABS traction system will disable traction control to prevent brake fade. The system will re-enable traction control after a short period of time.

TRACTION CONTROL AT VEHICLE SPEEDS ABOVE 25 MPH

If wheel spin occurs at any speed above 25 mph, the EC-17™ controller will instantly blink the traction dash lamp to advise the driver that a wheel spin is occurring.

If the torque limiting feature is programmed in, the EC-17™ controller uses its link to the engine control module and sends a signal to reduce engine torque to a level suitable for the available traction.

NOTE: THE EC-17™ CONTROLLER WILL NOT SIGNAL THE ATR™ VALVE TO APPLY THE BRAKES, EVEN SLIGHTLY, AT ANY SPEED ABOVE 25 MPH.

ANTILOCK AND TRACTION SYSTEM OPERATION DURING COMPONENT FAILURE

The Bendix® EC-17™ controller handles equipment failure using a conservative fail safe philosophy. Any single electrical failure of a component devoted to antilock or traction control results in simultaneous illumination of the appropriate condition lamp on the dash, a disabling of part or all of the antilock or traction system, and reversion to standard braking on wheels no longer under EC-17™ controller control.

Depending upon the type of failure and its position of occurrence, the EC-17™ controller disables all or only a portion of the antilock and traction system. A power or controller failure, however, will result in complete disabling of both systems and reversion to standard (non-antilock) braking is still available on all wheels.

There are a variety of ways to clear diagnostic trouble codes detected by the system. In most cases, the system will reset the diagnostic trouble code condition when the source of the original diagnostic trouble code has returned to a normal state for a period of time. Isolated diagnostic trouble codes are able to be reset by the system, but repeated occurrence (and self-clearing) of some diagnostic trouble codes will require a manual reset. This is done to aid in the troubleshooting of intermittent diagnostic trouble codes. The PC interface (or optional magnetic reset) is used to manually clear diagnostic trouble codes.

AUTO CALIBRATION

For optional ATC performance the ECU utilizes a feature referred to as auto calibration. Auto calibration allows the ECU to compensate for various tire sizes throughout the life of the vehicle. As there are many conditions that can result in the appearance of a change in the tire size, several items must be satisfied before the auto calibration feature is active. The auto calibration feature would automatically change the ECUs imbedded tire sizes if the difference exceeded approximately 8%. If issues occur with your ATC due to tire size changes please contact 1-800-AIR-BRAKE or 1-800-247-2725 for assistance.

SINGLE FAILURE

The following list and chart describes how the antilock and traction systems respond to a specific component failure. (Note: right and left; front, mid and rear are determined from the driver's seat. Left front is therefore the corner closest to the driver.)

For example, if the right mid sensor ("RM Sensor" on the chart) fails, front and rear antilock will still be operative. Traction will be disabled. On those axles where antilock is disabled the system reverts to standard air braking.

Front modulator - If a front modulator fails, antilock on that wheel is disabled. Antilock and traction on all other wheels remains active.

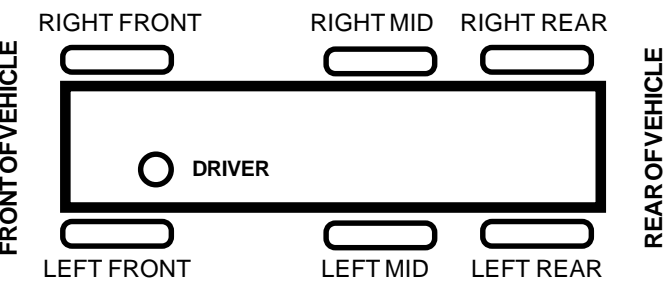
Rear modulator - A rear modulator failure disables the traction system. Antilock on that wheel will also be disabled, but antilock on all other wheels remains active.

Front sensor - The wheel is still modulated using input from the opposite sensor on the front axle. The traction system is disabled.

Mid or rear sensor - In a four sensor system, antilock on that wheel(s) is disabled, but antilock on all other wheels remains active. In a six sensor system, antilock remains active using input from the remaining functional sensor. In both the four and six sensor system traction control is disabled.

Controller - Antilock and traction are disabled. The system reverts to standard air braking.

Traction solenoid - Traction control is disabled. Antilock remains active.



SYSTEM STILL OPERATING (YES/NO)							
DIAGNOSTIC TROUBLE CODE LOCATION	Failed Device	ABS Front		ABS Rear		Traction	Std. Braking
		Left	Right	Left	Right		
	RF Sensor	YES	YES	YES	YES	NO	YES
	LF Sensor	YES	YES	YES	YES	NO	YES
	RM Sensor	YES	YES	YES	YES	NO	YES
	LM Sensor	YES	YES	YES	YES	NO	YES
	RR Sensor	YES	YES	YES	NO ¹	NO	YES
	LR Sensor	YES	YES	NO ¹	YES	NO	YES
	RF Modulator	YES	NO	YES	YES	YES	YES
	LF Modulator	NO	YES	YES	YES	YES	YES
RR Modulator	YES	YES	YES	NO	NO	YES	
LR Modulator	YES	YES	NO	YES	NO	YES	
Controller	NO	NO	NO	NO	NO	YES	
Tract. Solenoid	YES	YES	YES	YES	NO	YES	
Engine Control Module ²	YES	YES	YES	YES	NO	YES	
Voltage ²	NO	NO	NO	NO	NO	YES	
¹ ABS is still available in 6 sensors system if mid sensor is functional							
² When ECM wiring or voltage "corrects" itself, system is restored.							

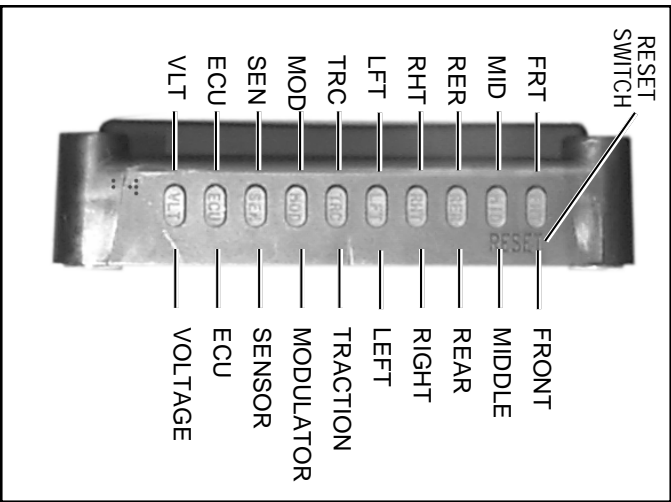


FIGURE 7 - EC-17™ CONTROLLER LED DIAGNOSTIC DISPLAY

Engine Control Module - If the engine control module (ECM) or the wiring from the EC-17™ controller to the ECM fails, traction control is disabled. Antilock remains active.

Voltage - If system voltage is out of range, antilock and traction are disabled. The system reverts to standard air braking.

MULTIPLE FAILURES

In the event that multiple failures occur, the dash lamp will react as it normally would during a single failure, and the EC-17™ controller equipped with LEDs will show one diagnostic trouble code at a time. When the first diagnostic trouble code is fixed and the system is reset, the next diagnostic trouble code area will appear at the LEDs. This way, the driver or mechanic does not lose track of diagnostic trouble code areas, and the system is not restored until each and every error is corrected and the EC-17™ controller is cleared of all diagnostic trouble codes.

ANTILOCK AND TRACTION WIRING

GENERAL NOTES

The wires that carry information and power into and out of the EC-17™ controller are generally grouped and terminate at a connector. The wire groups or wire harnesses along with the connectors are most often specified and/or supplied by the vehicle manufacturer. The connectors used on the EC-17™ controller are illustrated in Figure 5. The wiring harnesses and connectors are weather resistant and the wires that enter the connector are sealed to the connector. The wire gauge used in the wire harnesses is specific to the task performed.

When diagnosing wiring in the antilock system the following general rules apply and should be followed where applicable:

1. It is generally advisable to replace a wire harness rather than repair individual wires in the harness. If a splice repair must be made, it is important that the splice be properly soldered with a water based or thoroughly cleaned rosin flux (not acid based) and made water proof.
2. Do not pierce wire insulation when checking for continuity. Check for power, ground or continuity by disconnecting the connector and testing the individual pins or sockets in the connector.
3. Do not spread or enlarge individual pins or sockets during probing.
4. Always check the vehicle handbook for wire and connector identification. Individual wire identification will differ depending upon the type of connectors in use, the vehicle manufacturer, and the system features in use.
5. While the retarder disable, serial link, and traction on/off connections are present on all EC-17™ controllers, they are not always used.

PREVENTIVE MAINTENANCE

Every 3 months; 25,000 miles; or 900 operating hours;

1. Check all wiring and connectors to ensure they are secure and free from visible damage.
2. Although the EC-17™ controller incorporates self check diagnostics, the optional LED display should be inspected to ensure that it is functional. With the vehicle ignition on, a magnet (800 gauss; capable of picking up 3 ounces) held to the LED reset switch (indicated on the housing) should cause all of the LEDs to illuminate. If one or more of the LEDs DO NOT ILLUMINATE and the dash condition lamps indicate the system is functioning properly, the non-illuminated LED(s) should be noted for future reference. Although the diagnostic capabilities will be limited, the system will continue to function as designed.
3. Road test the vehicle by making an antilock stop from a vehicle speed of 20 miles per hour. When an antilock

stop is made, the modulator solenoids pulsate and an audible burst of air can be heard from outside of the cab. The wheels should not enter a prolonged "lock" condition. Also, make a traction acceleration by accelerating on a road surface with reduced traction. As with antilock, audible bursts of air can be heard when the traction system is functioning.

4. EC-17™ controllers not equipped with an LED display require the use of separate diagnostic tools capable of using the S.A.E. J1587 diagnostic Link.

WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times.

1. Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear safety glasses.
2. Stop the engine and remove ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, **EXTREME CAUTION** should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.
3. Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
4. If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle. If the vehicle is equipped with an AD-IS™ air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.
5. Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.
6. Never exceed manufacturer's recommended pressures.
7. Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.
8. Use only genuine Bendix® replacement parts, components and kits. Replacement hardware, tubing, hose, fittings, etc. must be of equivalent size, type and strength as original equipment and be designed specifically for such applications and systems.

9. Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.
10. Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.
11. For vehicles with Antilock Traction Control (ATC), the ATC function must be disabled (ATC indicator lamp should be ON) prior to performing any vehicle maintenance where one or more wheels on a drive axle are lifted off the ground and moving.

REMOVING THE EC-17™ CONTROLLER

EC-17™ CONTROLLER MOUNTED ON ANTILOCK RELAY VALVE OR ANTILOCK TRACTION RELAY VALVE

1. Remove as much contamination as possible from the assembly's exterior. Keep the contamination away from the open ports and electrical connections.
2. Identify and remove all air lines connected to the unit.
3. Disconnect the electrical connector(s) from the EC-17™ controller.
4. Note and mark the mounting position of the assembly on the vehicle. Loosen, remove and save the nuts on the mounting hardware that attaches the controller relay assembly bracket to the vehicle. Remove the relay valve and EC-17™ controller from the vehicle.
5. Note and mark the position of the EC-17™ controller relative to the valve it is mounted on. Remove and retain the four hex head bolts that secure the EC-17™ controller to the valve. Then separate the EC-17™ controller from the valve.

BRACKET MOUNTED EC-17™ CONTROLLER

1. Remove as much contamination as possible from the assembly's exterior. Keep the contamination away from open air connections and electrical connections.
2. Disconnect the electrical connector(s) from the EC-17™ controller.
3. Note and mark the mounting position of the EC-17™ controller on the vehicle. Loosen, remove and save the nuts on the mounting hardware that attaches the EC-17™ controller bracket to the vehicle. Remove the EC-17™ controller and bracket from the vehicle.
4. Remove and retain the four hex head bolts that secure the EC-17™ controller to the bracket. Separate the EC-17™ controller from the bracket.

INSTALLING THE EC-17™ CONTROLLER

EC-17™ CONTROLLER MOUNTED ON ANTILOCK RELAY VALVE OR ANTILOCK TRACTION RELAY VALVE

1. After noting the relationship of the positioning marks made prior to disassembly, position and secure the EC-17™ controller to the valve using the four hex head bolts. Torque the hex head bolts to 98 lbs. in. (Grade 5 bolts).
2. Mount the assembled EC-17™ controller and antilock relay valve on the vehicle and orient it in the position marked before removal.
3. Reconnect all air lines to the assembly.
4. Reconnect the electrical connector(s) to the EC-17™ controller and torque the connector retaining screw ("jack screw") to 15-20 inch pounds.
5. Test the valve for operation and leakage prior to placing the vehicle in service.
6. Perform the "Initial Start up Procedure" in the TROUBLESHOOTING section to assure proper system operation. (Appropriate for both EC-17™ & EC-17N™ controllers).

BRACKET MOUNTED EC-17™ CONTROLLERS

1. Secure the EC-17™ controller to its bracket using the four hex head bolts. Torque to 98 lbs. in (Grade 5 bolts).
2. After noting the positioning marks, mount the EC-17™ controller on the vehicle using the mounting hardware retained during removal.
3. Reconnect the electrical connector(s) to the EC-17™ controller and torque the connector retaining bolts to 15-20 inch pounds.
4. Perform the "Initial Start up Procedure" in the TROUBLESHOOTING section to assure proper system operation.

DIAGNOSING AND LOCATING A SYSTEM DIAGNOSTIC TROUBLE CODE

GENERAL

The EC-17™ controller contains self test and diagnostic circuitry that continuously checks for proper operation of the entire antilock/traction system, including wiring continuity. The EC-17™ & EC-17N™ controllers are programmed at the factory to accommodate the needs of the vehicle and the customer's desires. Both the EC-17™ & EC-17N™ controller can be reconfigured by the end user to include traction control (See the Important notice concerning the EC-17N™ controller). A vehicle equipped with traction control can generally be identified by noting the presence of a dash mounted condition lamp, a disable switch (for the traction control system) and a traction solenoid located above the relay valve.

Separate dash lamps, controlled by the EC-17™/EC-17N™ controller, advise the driver of the condition of the entire antilock/traction system.

When the controller senses an erroneous condition, it stores the condition in memory, illuminates the dash mounted condition lamp and after certain criteria are met it disables the antilock or traction control function. If so equipped, the EC-17™ controller illuminates the appropriate diagnostic LEDs.

The diagnostic trouble code condition is truly stored and is not cleared by loss of power to the antilock system. The optional LEDs will illuminate when power is restored and remain illuminated until the failure is corrected. After the actual issue is corrected, maintenance personnel can clear or reset the EC-17™ controller diagnostics through the S.A.E. J1587 diagnostic link or the optional magnetic RESET point in the diagnostics display. To clear or reset an EC-17N™ controller (not equipped with LEDs) the S.A.E. J1587 diagnostic link must be utilized.

IMPORTANT:

The balance of this manual deals with diagnostics and controller self-configuration using the optional LED display on the EC-17™ controller (see Figure 1). Antilock systems using the EC-17N™ controller (see Figure 1) must use the Bendix, Diagnostic Communication Interface or DCI for diagnostics or reconfiguration.

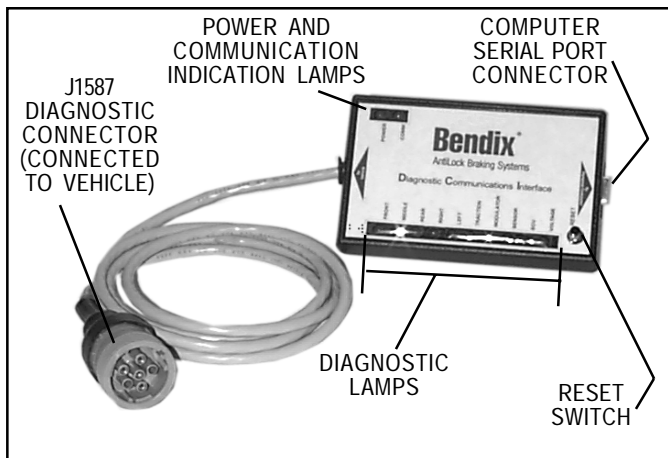


FIGURE 8 DIAGNOSTIC COMMUNICATIONS INTERFACE

DIAGNOSTIC COMMUNICATION INTERFACE

The DCI (part # 5004893) is a dual level electronic diagnostic tool for either the EC-17™ or EC-17N™ antilock controller. It can either be used as a "stand alone" diagnostic tool or with Bendix's ACom For Windows software (part # 5004892).

In order to use the DCI, the vehicle must be equipped with a J1587 diagnostic link connector as illustrated in Figure 9. This connector is generally located on the driver's side, in lower portion of the dash or under the dash panel.

MPSI Tool: Multi Protocol Cartridge (J38500-1500), PCMCIA Card For Bendix (J38500-2400).

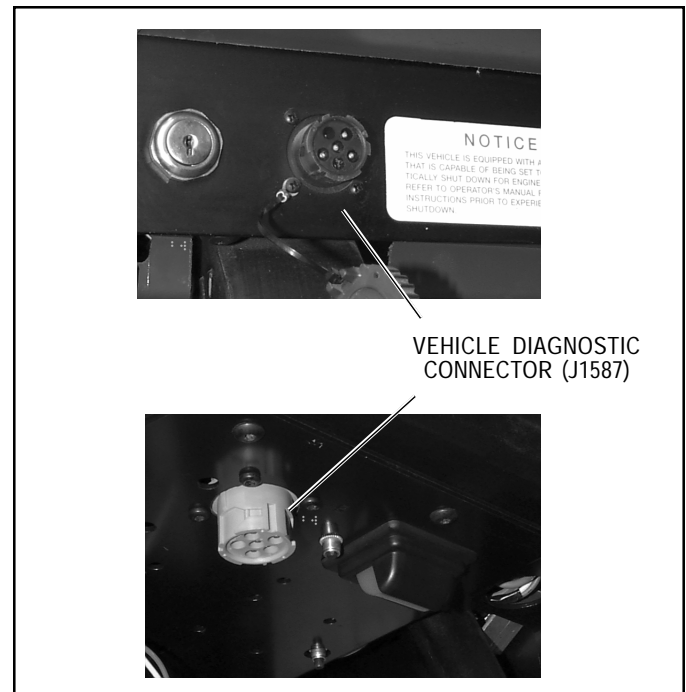


FIGURE 9 VEHICLE DIAGNOSTIC CONNECTOR LOCATION

Used with its Microsoft Windows* based software and a personal computer, the DCI is able to provide the technician with a high level of diagnostic information and antilock diagnostic trouble code history. This is particularly useful when attempting to determine the source of intermittent diagnostic trouble code indication from the antilock dash condition lamp.

For field use or when a PC is not available, the DCI's integral LED display and switch provides the EC-17N™ controller user with exactly the same information that is available from the optional LED display on the EC-17™ controller. When using the DCI's LED display for system diagnosis or controller self-configuration the descriptions and procedures presented

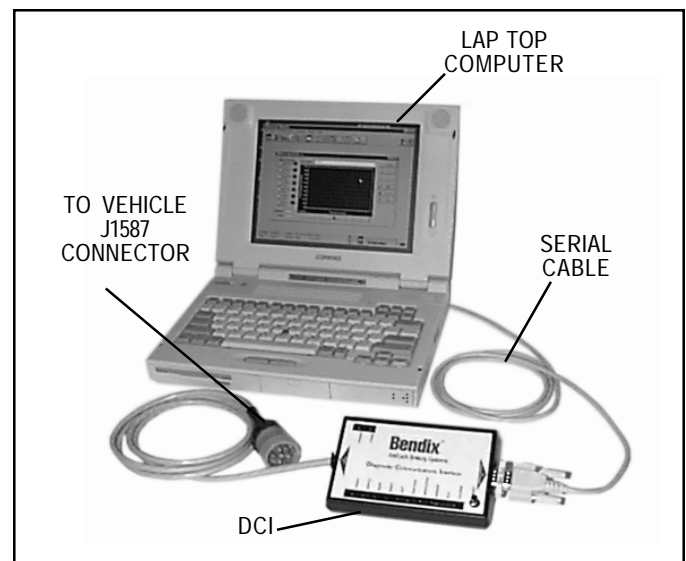


FIGURE 10 DCI CONNECTED TO LAP TOP COMPUTER

* Windows is a registered trademark of Microsoft Corporation.

LAMP CONFIGURATION TABLE

Torque Limiting & Differential Braking		Torque Limiting Only		Differential Braking Only		
ANTILOCK DASH LAMP	TRACTION DASH LAMP	ANTILOCK DASH LAMP	TRACTION DASH LAMP	ANTILOCK DASH LAMP	TRACTION DASH LAMP	
ON	ON	ON	ON	ON	ON	Both the Antilock & Traction dash lamps are ON during the system self test.
OFF ON	OFF ON	OFF ON	ON ON	OFF ON	OFF ON	This is the first blink occurrence of the Antilock dash lamp. Compare and note the traction lamp's reaction to the Antilock lamp.
OFF ON	OFF ON	OFF ON	OFF ON	OFF ON	ON ON	This is the second blink occurrence of the Antilock dash lamp. Compare and note the traction lamp's reaction to the Antilock lamp.
OFF	OFF	OFF	OFF	OFF	OFF	Both dashlamps are OFF and remain OFF at the end of the powerup sequence.

in this manual can be used. When connected to a PC, use the instructions and documentation packaged with the DCI to troubleshoot or reconfigure the EC-17™/EC-17N™ controller.

For more information on the Bendix Diagnostic Communication Interface, see your local authorized Bendix parts outlet or call 1-800-AIR-BRAKE (1-800-247-2725).

OPTIONAL DIAGNOSTIC LEDS & RESET

The condition of specific components is provided by a series of labeled, light emitting diodes (LEDs) in the EC-17™ controller housing. No special tools or equipment are needed to read or interpret the EC-17™ controller diagnostic display. It should be noted that the EC-17™ controller diagnostics display is separate from the antilock and traction condition lamps on the dash. With this separation, the driver is aware of any issues that occur but is not confused by diagnostic information. There are ten LEDs plus a magnetically actuated reset switch. The first six LEDs locate an issue to a specific area of the vehicle, and the next three indicate the component or its wiring. The LEDs are software driven and are either ON or OFF depending upon their monitor function. (*Note: right and left, front and rear are determined from the driver's seat.*) *Note: The non LED EC-17N™ controller is also not equipped with a magnetic reset.*

FRT	Red LED
MID	Red LED (See Note)
RER	Red LED

RHT	Red LED
LFT	Red LED
TRC	Red LED
MOD	Red LED
SEN	Red LED
ECU	Red LED
VLT	Green LED
RESET +	No LED

Note: The MID LED is used with some but not all vehicles. When six speed sensors are not installed this LED is not used in the diagnostic process. However, it will light when a magnet is placed on the RESET switch in the diagnostic display.

"FRT" (Front) LED

This Red LED illuminates in order to indicate the location of a component or its wiring. It will light in conjunction with either the RIGHT or LEFT LED and the MOD or SENS LED.

"MID" (Middle Axle) LED

This Red LED is not used in all installations. On those vehicles that have six speed sensors installed, this Red LED illuminates to indicate the location of a speed sensor or its wiring. The "MID" LED should not illuminate with the "MOD" LED.

"RER" (Rear) LED

This Red LED illuminates in order to indicate the location of a component or its wiring. It will light in conjunction with either the RIGHT or LEFT LED and the MOD or SENS LED.

"RHT" (Right) LED

This Red LED illuminates in order to indicate the location of a component or its wiring. It will light in conjunction with either the FRONT or REAR LED and the MOD or SENS LED.

"LFT" (Left) LED

This Red LED illuminates in order to indicate the location of a component or its wiring. It will light in conjunction with either the FRONT or REAR LED and the MOD or SENS LED.

"TRC" (Traction) LED

This Red LED illuminates to indicate a permanent diagnostic trouble code in the traction control system. It may be illuminated with the MOD LED or may illuminate by itself. *NOTE: If a problem may exist with the wiring to the engine control module (ECM), this LED will go on.*

"MOD" (Modulator) LED

This Red LED illuminates to indicate an open or short circuit in the solenoids of one of the four modulators or the wiring connecting them to the system. When indicating a diagnostic trouble code with a modulator this LED will be illuminated with two positioning LEDs (RHT/LFT + FRT/RER). *NOTE: The MID positioning LED should not be illuminated with this LED. This LED is also used to indicate a possible problem with an ATR-1™ or ATR-2™ valve, antilock traction relay, solenoid. When illuminated for a traction system diagnostic trouble code the TRC LED will also be on.*

"SEN" (Speed Sensor) LED

This Red LED illuminates to indicate an open or short circuit in one of the speed sensors or the wiring connecting them to the system. The "SEN" LED will be illuminated with two positioning LEDs (RHT/LFT + FRT/MID/RER).

"ECU" (Electronic Control Unit) LED

This Red LED, when illuminated, indicates that the controller itself has failed. Before controller replacement is considered, always check vehicle voltage to the controller.

"VLT" LED

This Green LED illuminates and remains ON during vehicle operation to indicate that vehicle power is reaching the controller. If vehicle power is out of range (below 10 VDC or above 18.0 VDC) this LED will flash until power is brought into range.

"RESET"

Beneath the RESET area of the display is a magnetically sensitive switch that is used to reset the diagnostic system. The device will respond to a magnet which has strength

sufficient to lift a three (3) ounce weight. Momentarily holding a magnet against the RESET will cause ALL LEDs to light during the time the magnet is against it. Holding a magnet against the RESET longer than 20 seconds will cause the EC-17™ controller to initiate the self configuration feature.

EC-17™ CONTROLLER CONFIGURATION

IMPORTANT GENERAL NOTE:

The following information and procedure applies to the EC-17™ controller equipped with the optional LED diagnostic display and magnetic RESET switch. Controllers without this option (EC-17N™) must use the J1587 diagnostic link and the DCI with its related computer programs to reconfigure the controller. See the documentation and instructions packaged with the equipment for specifics.

EC-17™ CONTROLLER CONFIGURATION DISPLAY

1. Turn the ignition ON.
2. All LEDs will illuminate then go out.
3. The number of active sensors will be displayed by the momentary illumination of the red SEN (sensor) LED and two or more of the red locating LEDs. No other LEDs will be on.
 - A. SEN + FRT (front) + RER (rear) = A four sensor configuration (all systems must have at least a 4 sensor configuration)
 - B. SEN + FRT + MID (middle) + RER = A six sensor configuration
4. The red TRC LED will momentarily illuminate by itself if traction control torque limiting is active, if not, then the display will go to the condition described in #5.
5. The red TRC and MOD LEDs will momentarily illuminate if traction control differential braking is active, if not, then the display will go to the condition described in #6. No other LEDs will be on.
6. The diagnostic display will return to its normal operational status. Assuming no diagnostic trouble codes exist in the antilock or traction system, all red LEDs will be off and the single, green, VLT LED is illuminated.

EC-17™ CONTROLLER SELF CONFIGURING PROCESS

Important General Information:

1. Three aspects of the antilock and traction system are influenced by the self configuring feature of the EC-17™ controller.
 - A. **Speed Sensors:** The number of speed sensors connected to the EC-17™ controller will be detected during the self configuration process. The EC-17™ controller will check the MID SEN (mid axle speed sensor) locations on its connector to determine if a sensor is connected to it and will default to a six sensor configuration if it detects even one sensor

connected. If mid axle speed sensors are not detected, the EC-17™ controller will default to a four sensor configuration. (Two front and two rear)

- B. **Electronic Engine Control:** On units manufactured prior to mid-year 2000, if the EC-17™ controller is connected to the control module of an electronic engine, the torque limiting and differential braking feature of ATC will be activated when the traction enable/disable switch is toggled prior to self configuration. After mid-year 2000, the electronic engine must transmit the throttle position via the J1922 or J1939 serial link for ATC to be activated during wheel spin.
 - C. **Antilock Traction Relay Valve:** If the solenoid assembly in the ATR™ valve is connected to the EC-17™ controller, the differential braking feature of traction control will be activated during the self configuring process.
 - D. **Traction Disable Switch:** The traction disable switch must be toggled prior the self configuration process.
2. No method is available to disable the self configuration feature.
 3. Due to the extended period of time the magnet must be held on the RESET to initiate the self configuration process (20 seconds), it is unlikely that a self configuration would occur accidentally.
 4. Basic, four speed sensor, antilock operation can not be removed during the self configuration process. This is a minimum configuration for all EC-17™ controllers.
 5. If a speed sensor is connected to either wheel on the mid axle, the EC-17™ controllers will configure for six sensors. If no mid axle speed sensor is detected, the EC-17™ controller will configure for four sensors. Any disconnected speed sensor(s) will register as a failure on the diagnostic display at the end of the EC-17™ controller self test.
 6. All or part of traction control can be lost during self configuration by;
 - A. Not connecting one of the wire harnesses (engine control module for torque limiting and ATR™ valve solenoid for differential braking).
 - B. A missing or inoperative traction control enable/disable switch.
 - C. Not toggling the traction control enable/disable switch in the "traction enabled" after power up, but prior to the self configuration. The operator can tell that the traction features are lost by noting the absence of the traction lamp flash upon power up. The operator should note the flashing of the antilock condition lamp, and the traction lamp if traction equipped, upon every power up. Observing the dash lamps is one

method the operator has to verify the system operation.

7. The EC-17™ controller can be reprogrammed up to 10,000 times.
8. When a replacement EC-17™ controller is installed on a vehicle that does not have one or more of the preprogrammed features, a failure will be registered on the dash lamp(s) and on the EC-17™ controller diagnostic display. For this reason it is necessary to perform the self configuring procedure.
9. Some configuration information is available by observing the reaction of the dash condition lamps on vehicles configured with traction control and equipped with the self configuring EC-17™ controller. When the ignition is switched ON, the EC-17™ controller self test is begun. During the self test the dash lamps will flash on and off together as indicated in the chart, depending upon the type and amount of traction control configured into the EC-17™ controller. *Note: For more information on this subject see the TROUBLESHOOTING section of this document.*

Self Configuration Process

In order to successfully complete the self configuring process follow the steps presented.

1. Connect all antilock and traction control wire harnesses. Refer to the schematic in Figure 5. Make certain that all the speed sensors present on the vehicle are connected (H2, H3, J1, J2 on the 30 pin connector and E2, E3, F2, F3, B2, B3, C2, C3 on the 18 pin connector). If the vehicle has an electronic engine and traction control torque limiting is desired the engine control module must be connected (B2 and B3 on the 30 pin connector for J1922 or C3, D2, and D3 on the 30 pin connector for J1939). If the vehicle is equipped with either an ATR-1™ or ATR-2™ valve, the solenoid connection must be made to the EC-17™ controller (D2 and D3 on the 18 pin connector) in order to obtain traction control differential braking.
2. If the vehicle is to be configured with traction control, it must have a traction control dash lamp and a traction control enable/disable switch. Both the lamp and switch must be functional.
3. Turn the ignition ON, toggle the traction control enable/disable switch back and forth then hold a magnet on the RESET position of the EC-17™ controller diagnostic display until the LEDs begin to flash then remove the magnet. If the magnet is not removed during the LED flashing a second self configuration may be initiated. The magnet may have to be held on the RESET for as long as 20 seconds. When the self configuration process is complete the EC-17™ controller will automatically go through a self test. During the self test the diagnostic display will indicate the new configuration as described under the section entitled EC-17™ Controller Configuration Display. *Note: If the EC-17™ controller is*

being configured with traction control (either torque limiting, differential braking or both), the traction control condition dash lamp, will be illuminated as well as the appropriate LEDs on the EC-17™ controller diagnostic display. The traction control dash lamp will be illuminated until the traction control enable/disable switch is placed in the traction control enabled position (traction control operative).

4. Place the traction control enable/disable switch in the traction control enabled position (traction control operative), the traction control dash lamp should be off.
5. Before placing the vehicle in service, verify the configuration and the system condition by turning the ignition OFF then ON while observing the EC-17™ controller diagnostic display. The diagnostic display should indicate the desired configuration as described under the section entitled EC-17™ Controller Configuration Display and no red LEDs should be illuminated at the end of the self test.
6. If the configuration appears correct but the diagnostic LEDs indicate a failure somewhere in the system, refer to the General Configuration Information section and use the Troubleshooting section of this manual to locate and repair the diagnostic trouble code.
7. If the configuration is incorrect, the process can be repeated as required. One common error is performing the self configuration without toggling the traction control enable/disable switch. This will prevent any traction features from being activated. *Note: The traction switch must be toggled to configure traction, but must be placed in the enable position to allow the traction lamp to flash.*

TROUBLESHOOTING

IMPORTANT BEFORE TROUBLESHOOTING:

1. Determine if the vehicle is equipped with traction control. The presence of a traction condition lamp on the dash can be used.
2. Some vehicles are equipped with a traction control "disabling switch." If so equipped, ENABLE THE TRACTION SYSTEM BEFORE BEGINNING THE TROUBLESHOOTING. THE TRACTION CONTROL MUST BE DISABLED FOR DYNAMIC TESTING.
3. If the vehicle is equipped with traction control and is a tandem axle unit, note the number of drive axles. The "MID" diagnostic LED is used only on 6x4 vehicles.

GENERAL

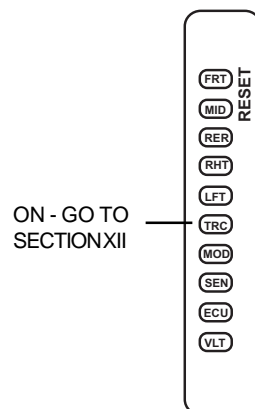
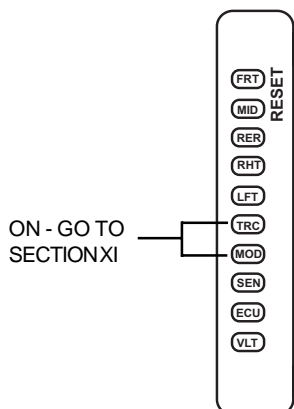
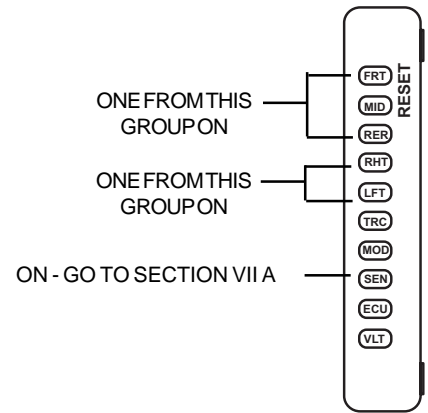
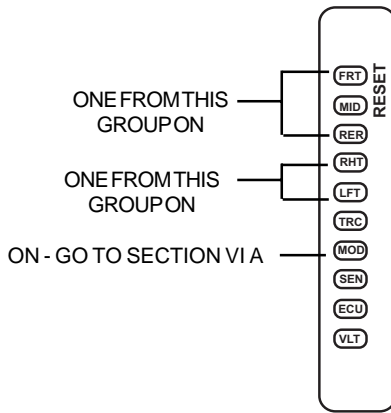
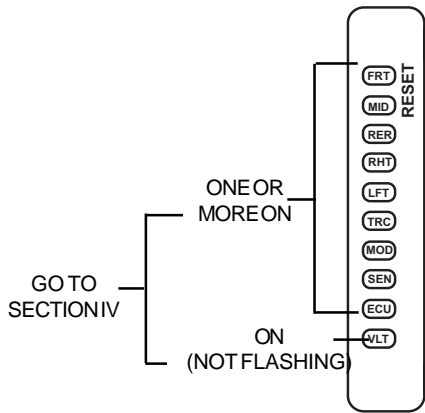
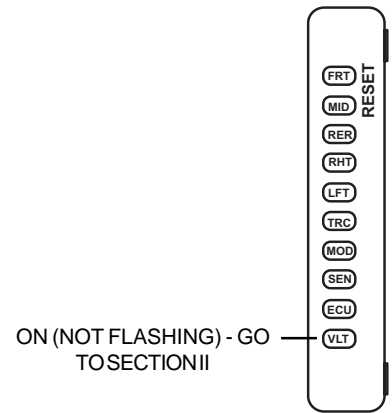
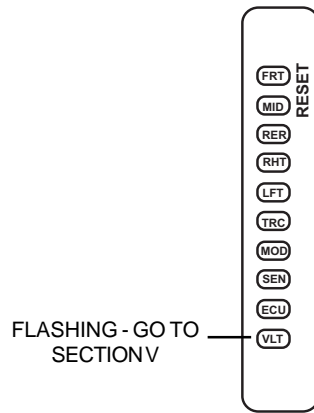
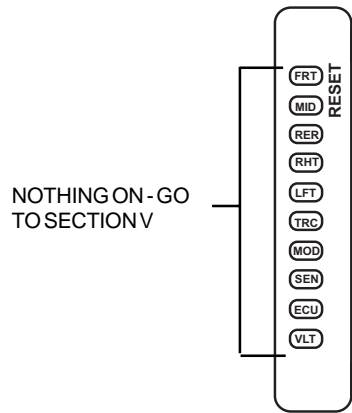
While the EC-17™ controller diagnostic display locates a specific diagnostic trouble code area, it is still necessary to confirm whether the problem may reside in the component itself or the wiring. The following troubleshooting procedure is devoted to narrowing the diagnostic trouble code to either the wiring or a specific antilock or traction component. It should be noted that ALL TROUBLESHOOTING BEGINS BY OBSERVING THE ANTILOCK AND TRACTION CONDITION LAMPS ON THE DASH. All troubleshooting should begin by first performing the "Initial Start up Procedure" and following the directions contained in it.

TROUBLESHOOTING TIPS

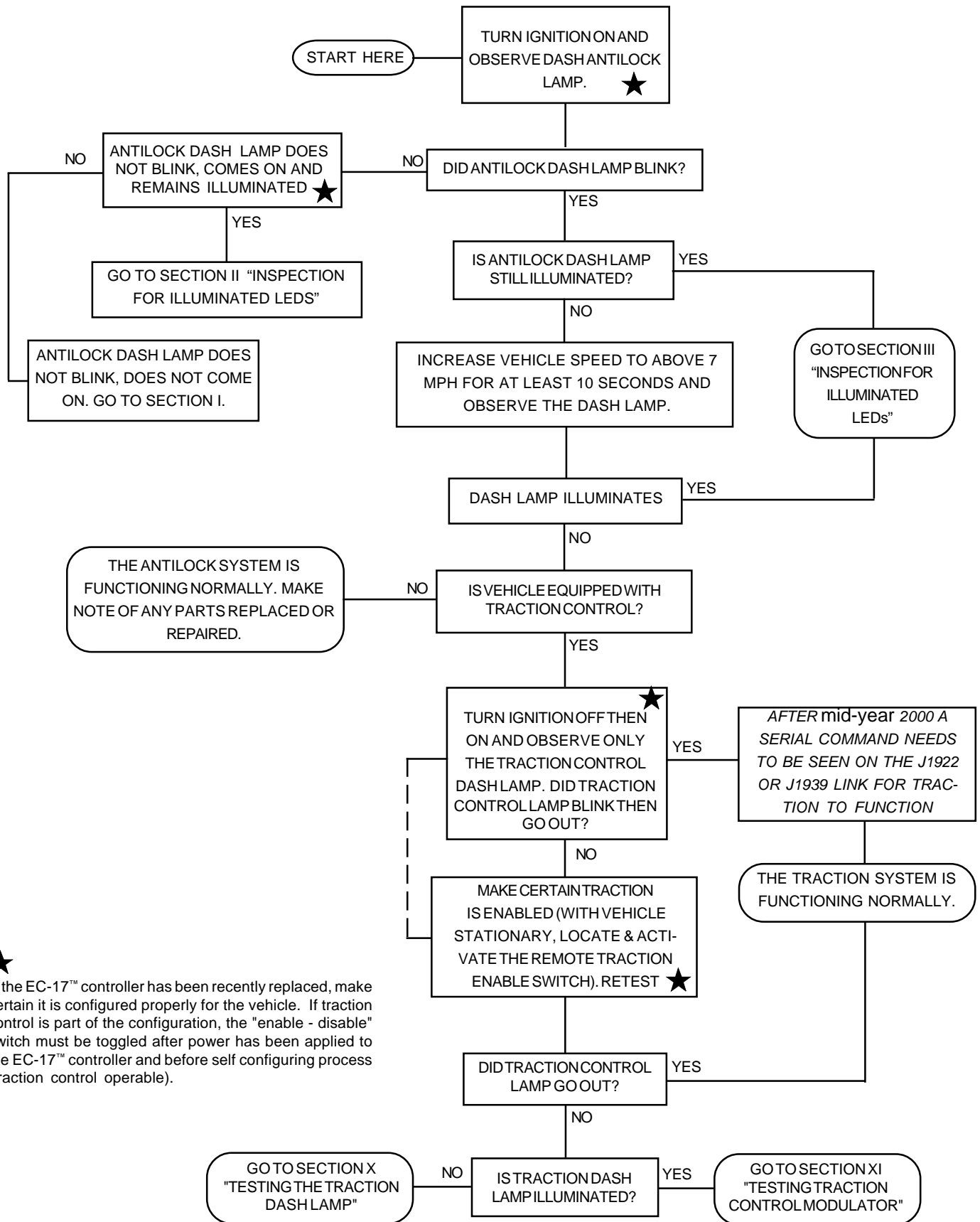
1. Begin by observing the dash condition lamp(s) and performing the "Initial Start Up Procedure."
2. The troubleshooting technician should record all findings and the action taken during the troubleshooting process.
3. No voltage or resistance tests are performed into the EC-17™ controller. All voltage and resistance tests are performed by beginning at the wire harness half of the connector and moving AWAY from the EC-17™ controller toward an antilock traction system component (modulator, wheel speed sensor, etc.)

DIAGNOSTIC DISPLAY QUICK REFERENCE

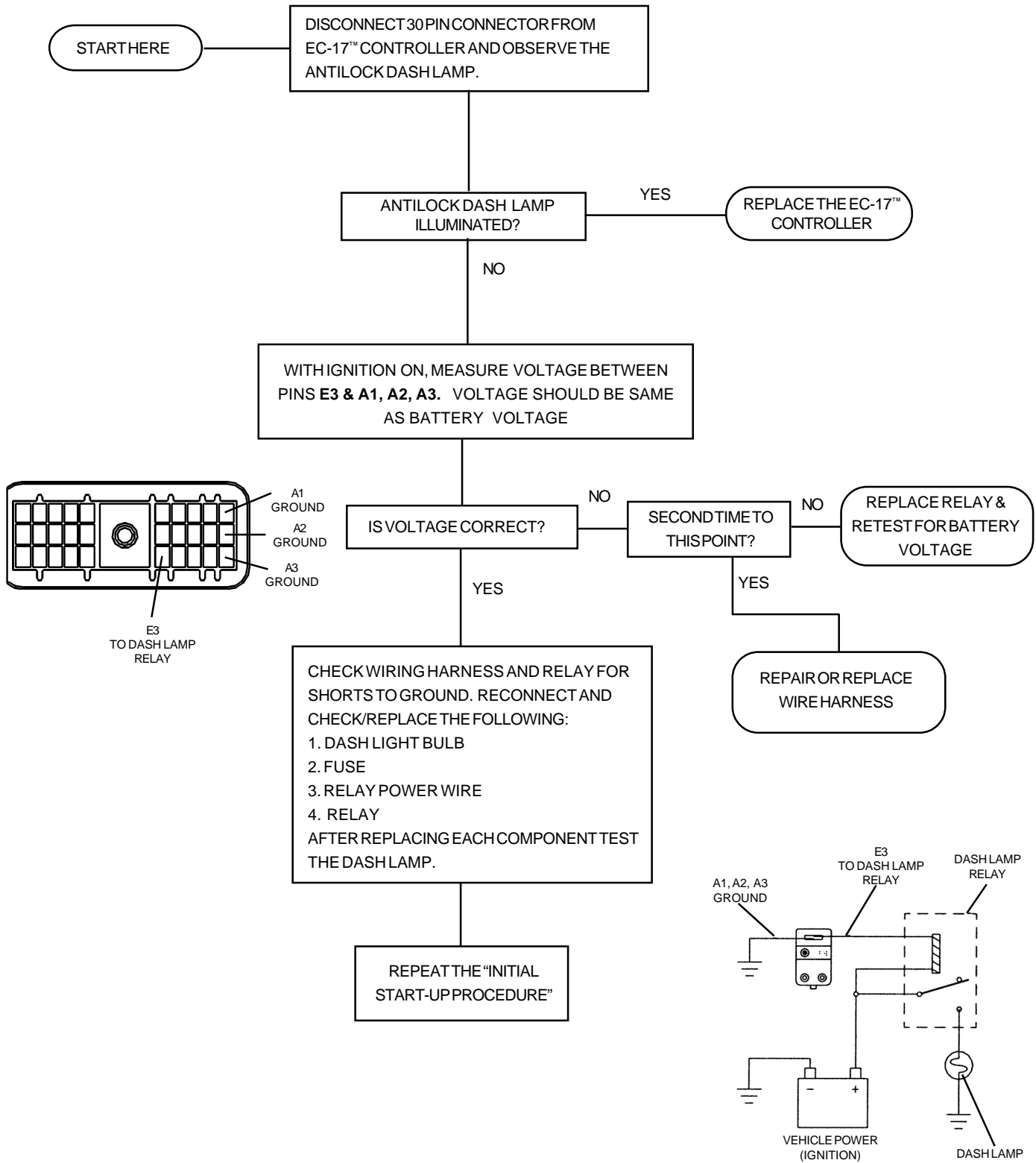
This index is presented for the benefit of personnel experienced in troubleshooting Bendix full-vehicle wheel control antilock with traction control. It provides a quick reference to specific sections that provide testing procedures and values.



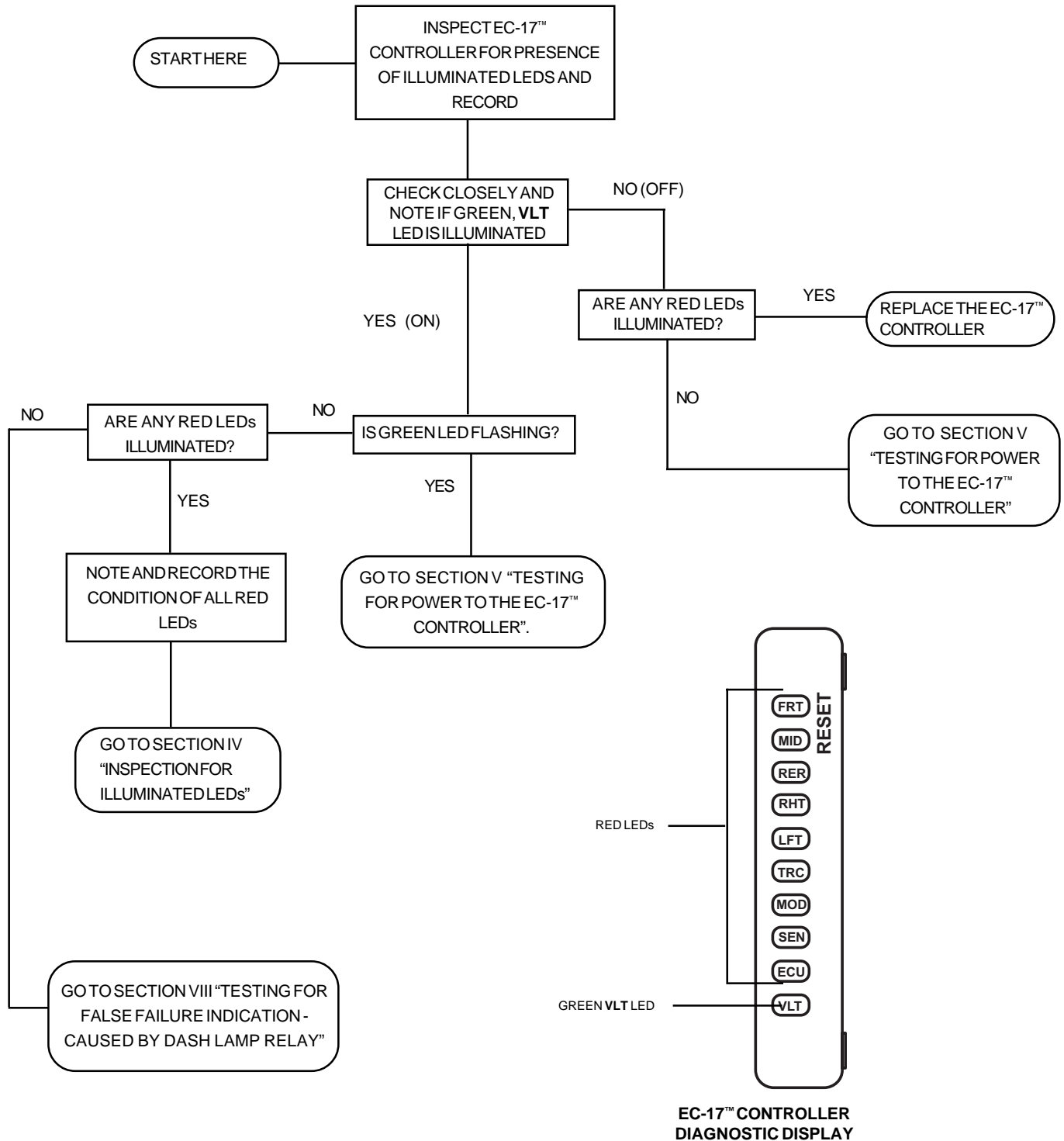
INITIAL START-UP PROCEDURE



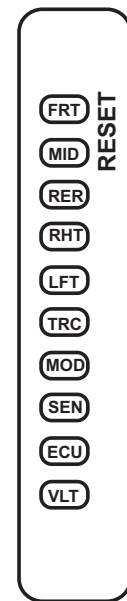
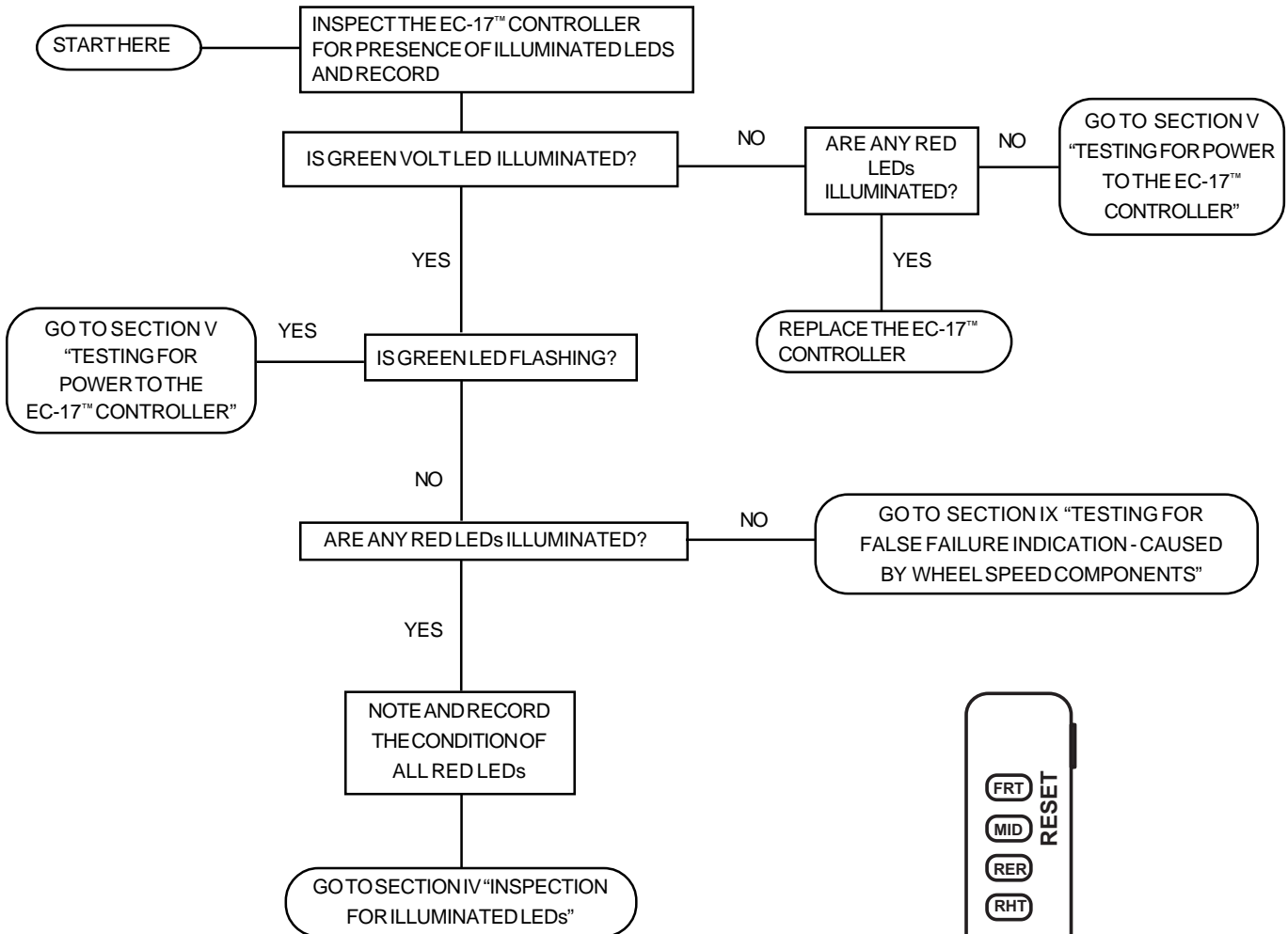
SECTION I - ANTILOCK DASH LAMP TESTING



SECTION II - INSPECTION FOR ILLUMINATED LEDs

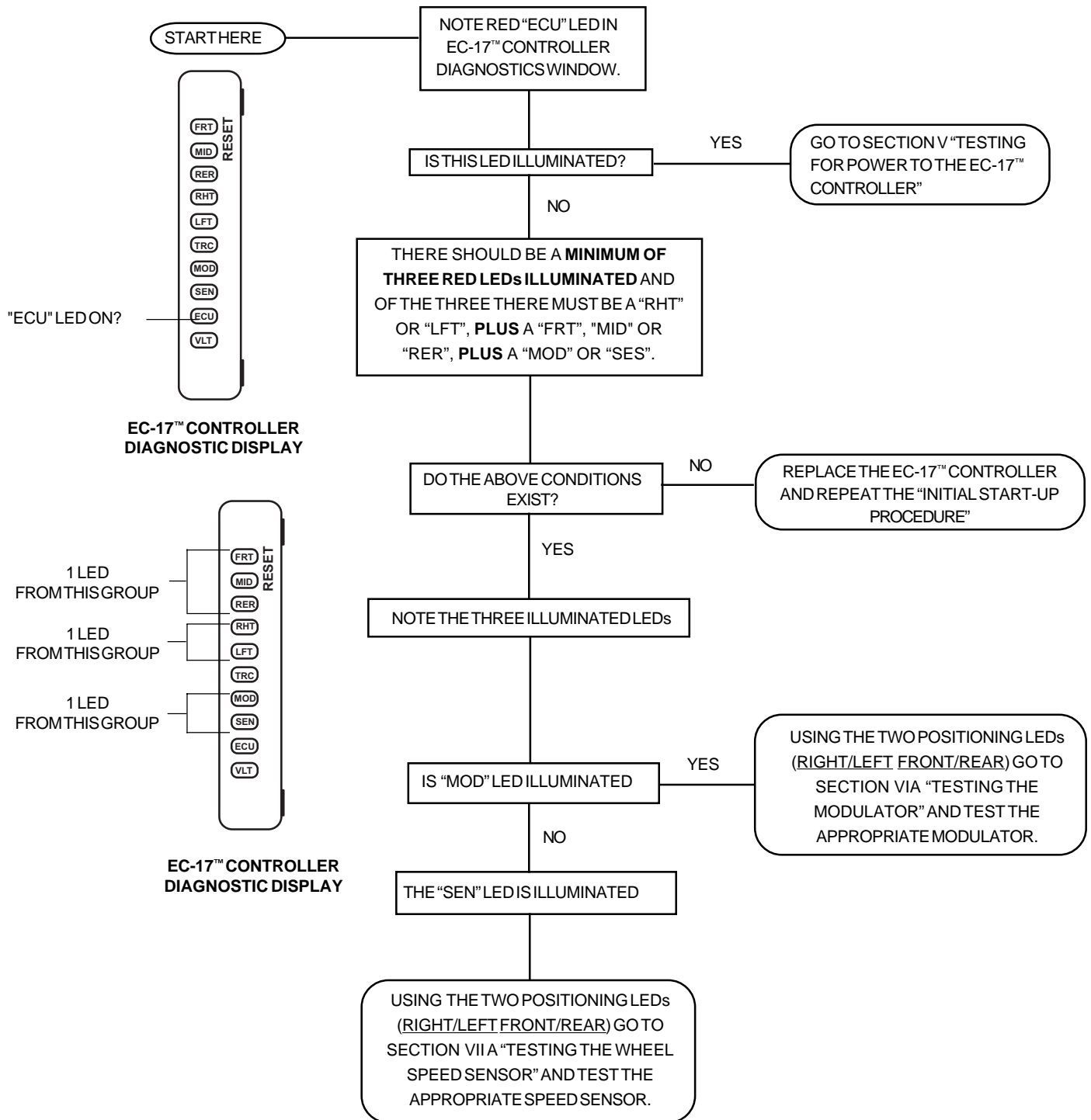


SECTION III - INSPECTION FOR ILLUMINATED LEDs

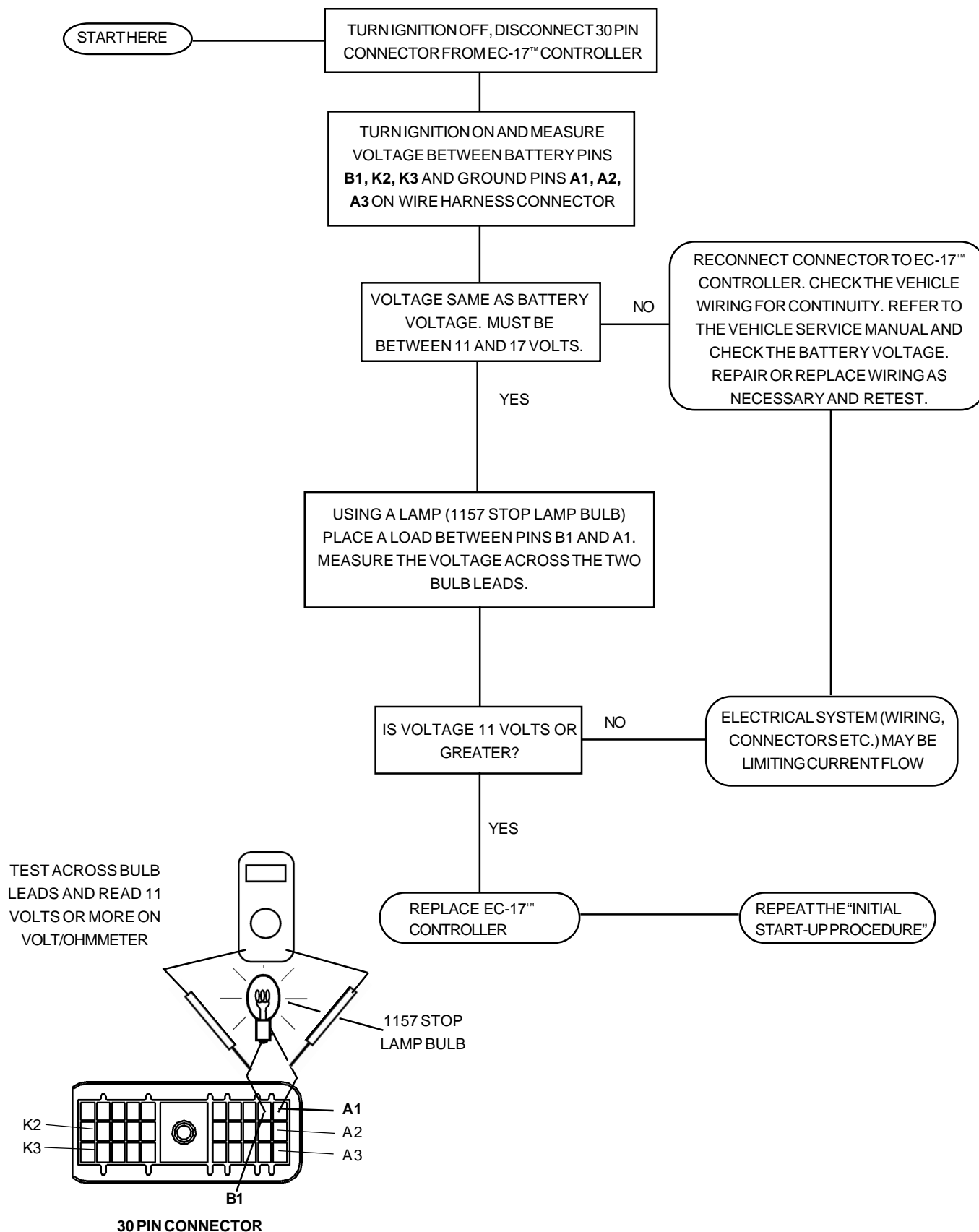


EC-17™ CONTROLLER
DIAGNOSTIC DISPLAY

SECTION IV - INSPECTION FOR ILLUMINATED LEDs



SECTION V - TESTING FOR POWER TO THE EC-17™ CONTROLLER



SECTION VI A - TESTING THE MODULATOR

TURN IGNITION OFF. REFER TO ILLUSTRATION, DISCONNECT WIRE HARNESS CONNECTOR FROM EC-17™ CONTROLLER.

START HERE

PROBE CONNECTOR WITH VOLT/OHM METER AND NOTE THAT PROPER RESISTANCE VALUES ARE OBTAINED FOR MODULATOR BEING TESTED.

RESISTANCE VALUES FOR BENDIX® M-21™ AND M-22™ MODULATORS.

HOLD TO COMMON:	READ 3.5 TO 5 OHMS
EXHAUST TO COMMON:	READ 3.5 TO 5 OHMS
EXHAUST TO HOLD:	READ 7 TO 10 OHMS

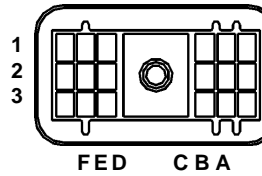
FOR BENDIX® M-32™ MODULATORS.

HOLD TO COMMON:	READ 4.9 TO 7 OHMS
EXHAUST TO COMMON:	READ 4.9 TO 7 OHMS
EXHAUST TO HOLD:	READ 9.8 TO 14 OHMS

PROBE CONNECTOR PINS WITH A MEGOHMMETER AND VERIFY THAT NO CONTINUITY EXISTS.

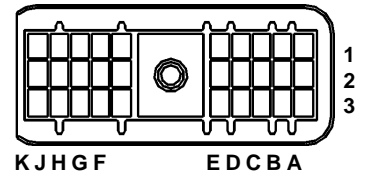
COMMON TO GROUND:	NO CONTINUITY
HOLD TO GROUND	NO CONTINUITY
EXHAUST TO GROUND	NO CONTINUITY

18 PIN CONNECTOR



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

30 PIN CONNECTOR



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

ARE RESISTANCE
VALUES CORRECT?

YES

INSPECT CONNECTOR AND RECONNECT TO EC-17™ CONTROLLER. TURN IGNITION ON AND PASS MAGNET OVER RESET ON EC-17™ CONTROLLER. NOTE REACTION OF RED LEDs.

NO

GO TO SECTION VI B AND
CONTINUE TESTING

ARE ANY RED LEDs
ILLUMINATED?

NO

REPEAT "INITIAL START-UP
PROCEDURE." IF THIS TEST STEP
HAS REPEATED TWICE - **REPLACE
THE EC-17™ CONTROLLER.**

YES

SAME RED LEDs
ILLUMINATED?

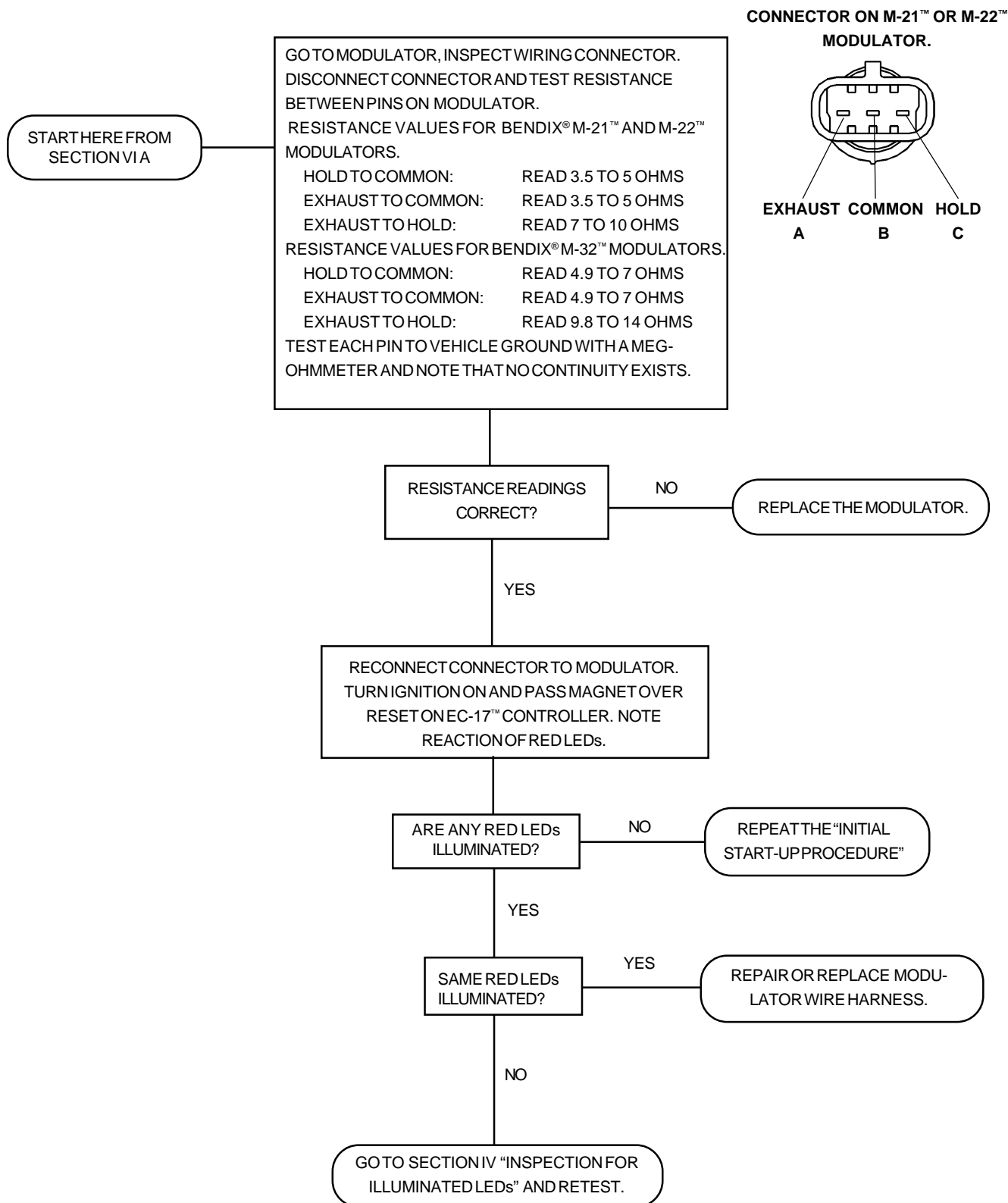
YES

**REPLACE THE EC-17™
CONTROLLER.**

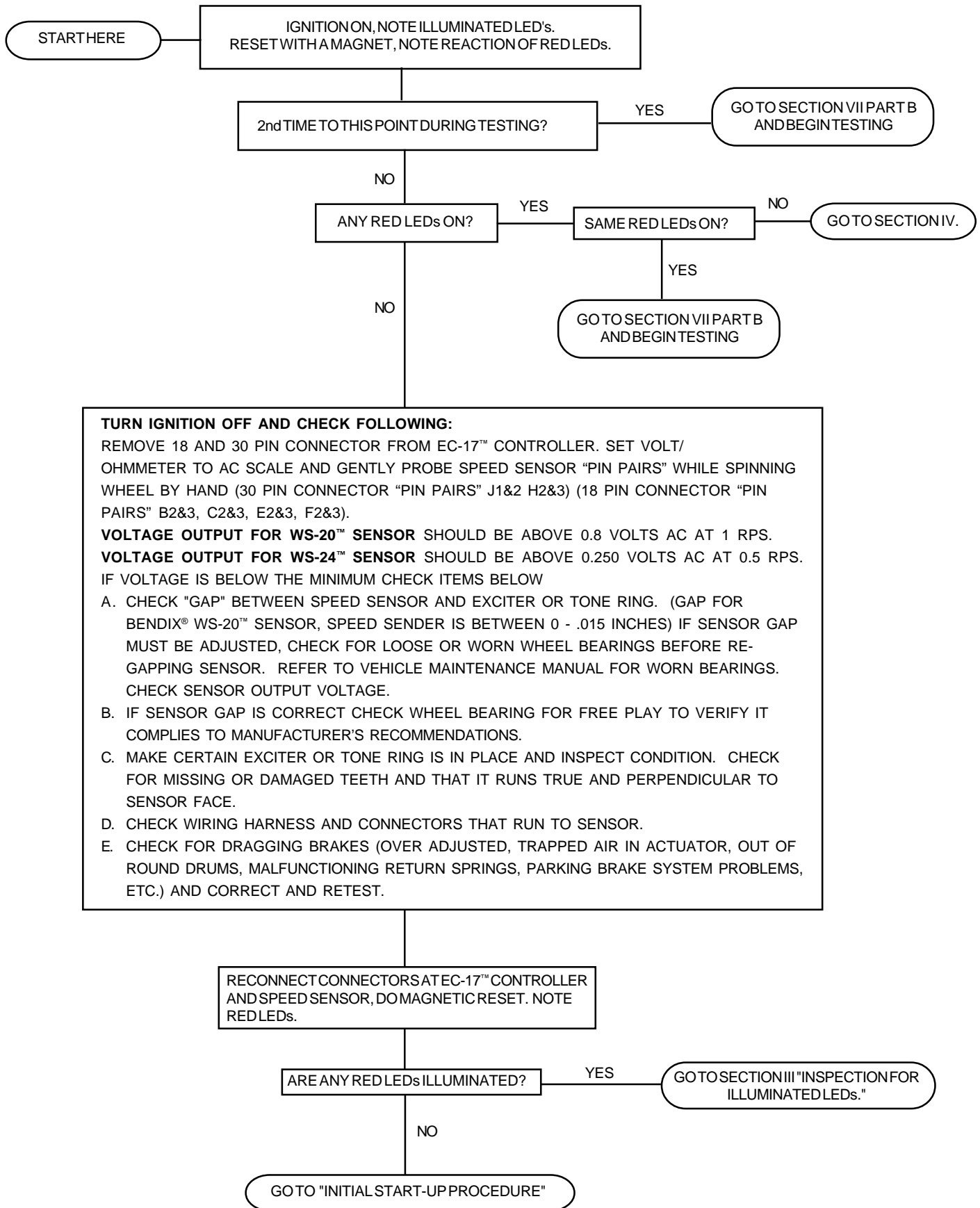
NO

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

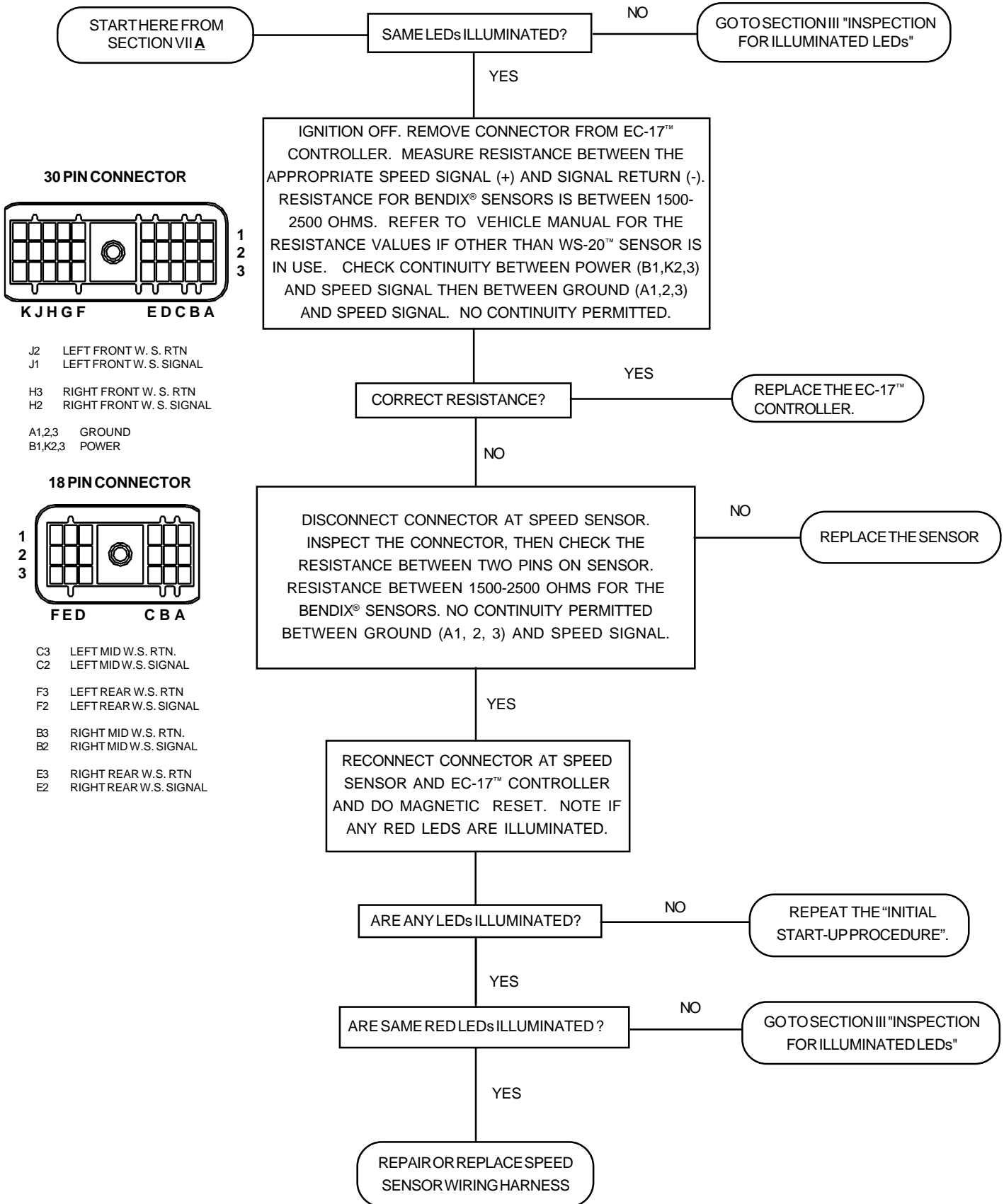
SECTION VI B - TESTING THE MODULATOR



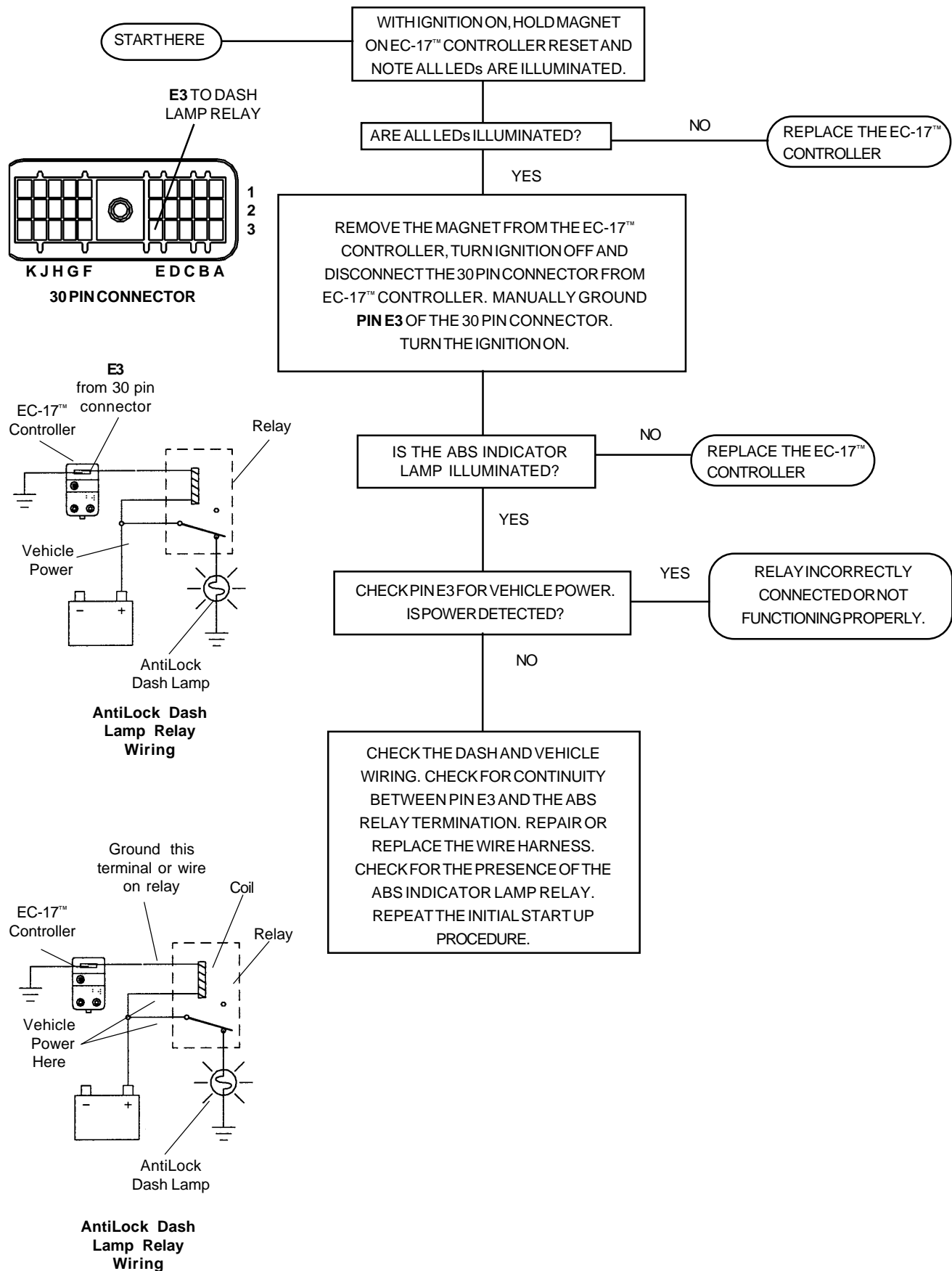
SECTION VII A - TESTING THE WHEEL SPEED SENSOR



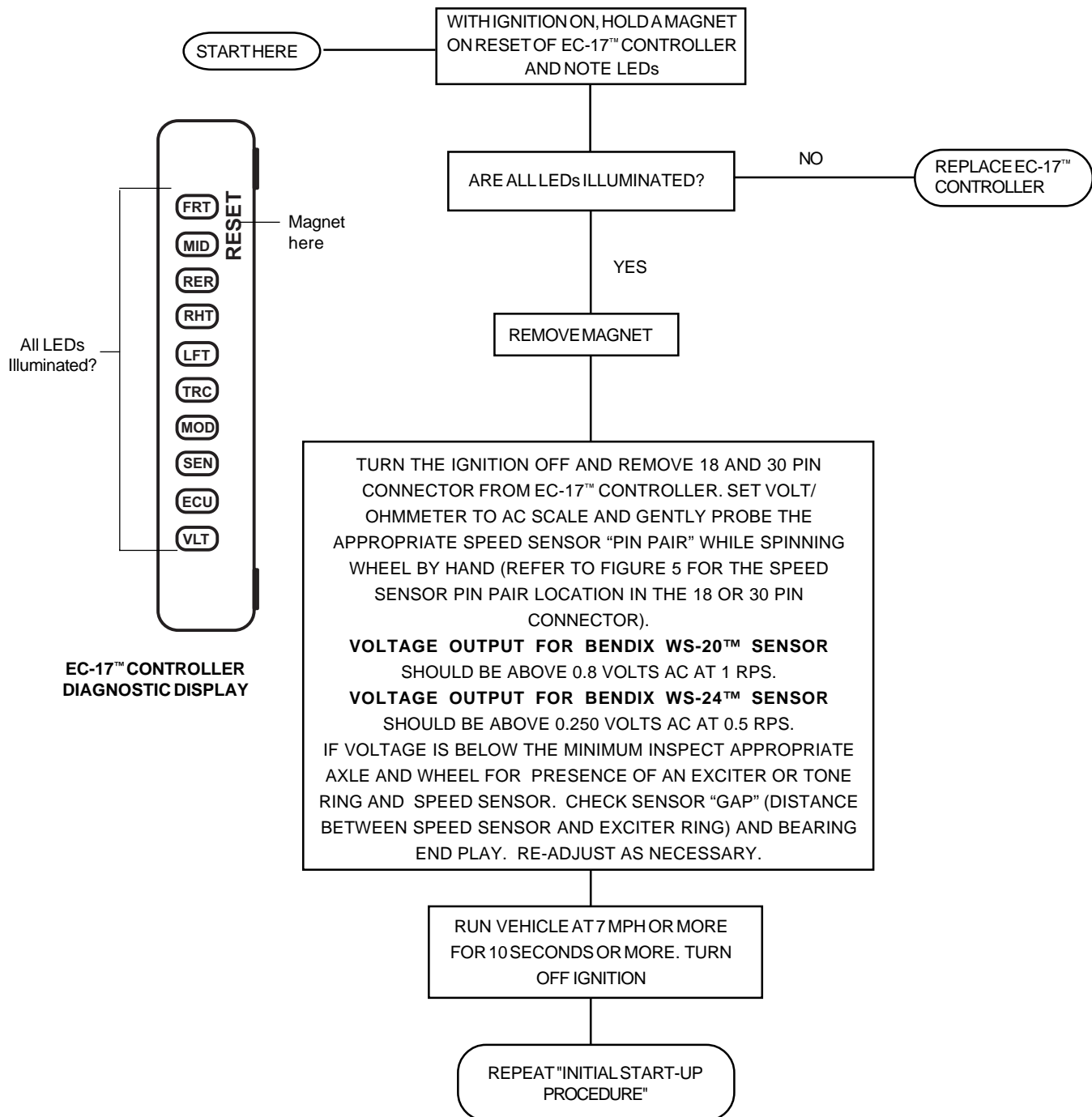
SECTION VII B - TESTING THE WHEEL SPEED SENSOR



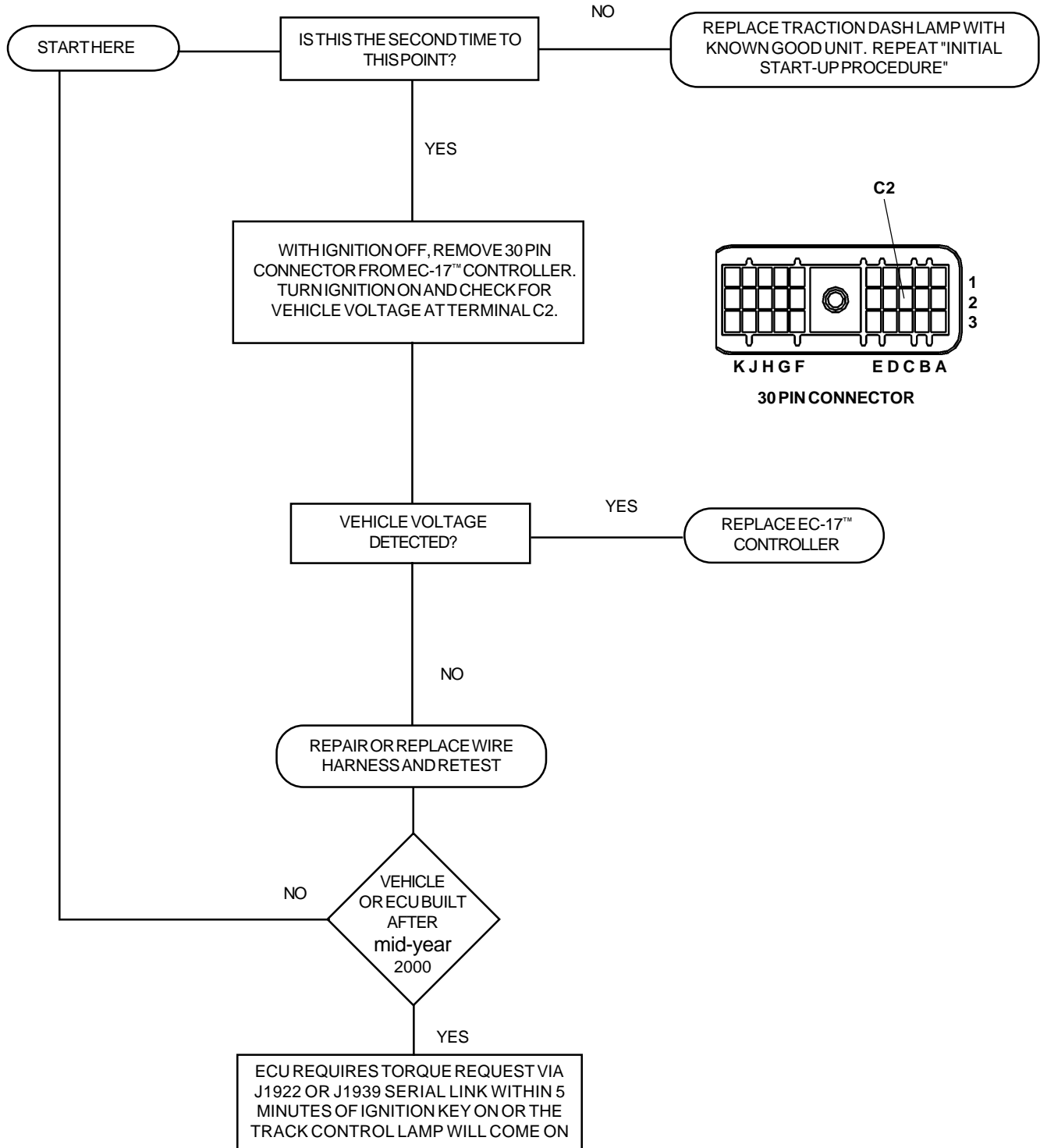
SECTION VIII - TESTING FOR FALSE INDICATION CAUSED BY DASH LIGHT RELAY



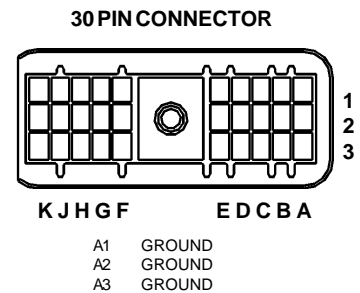
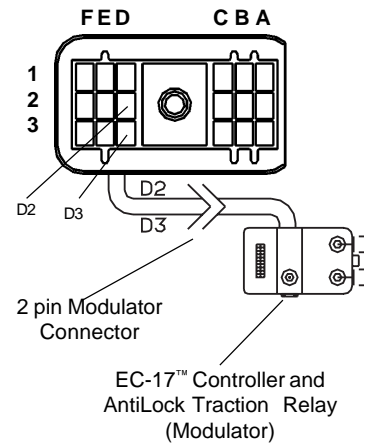
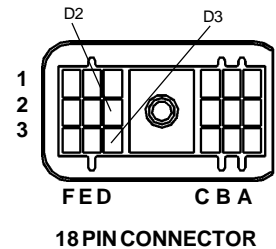
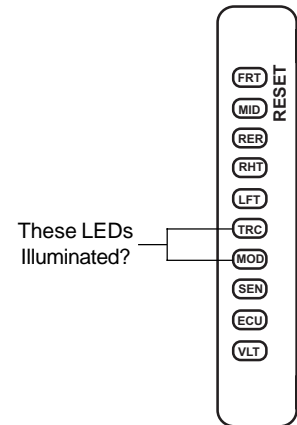
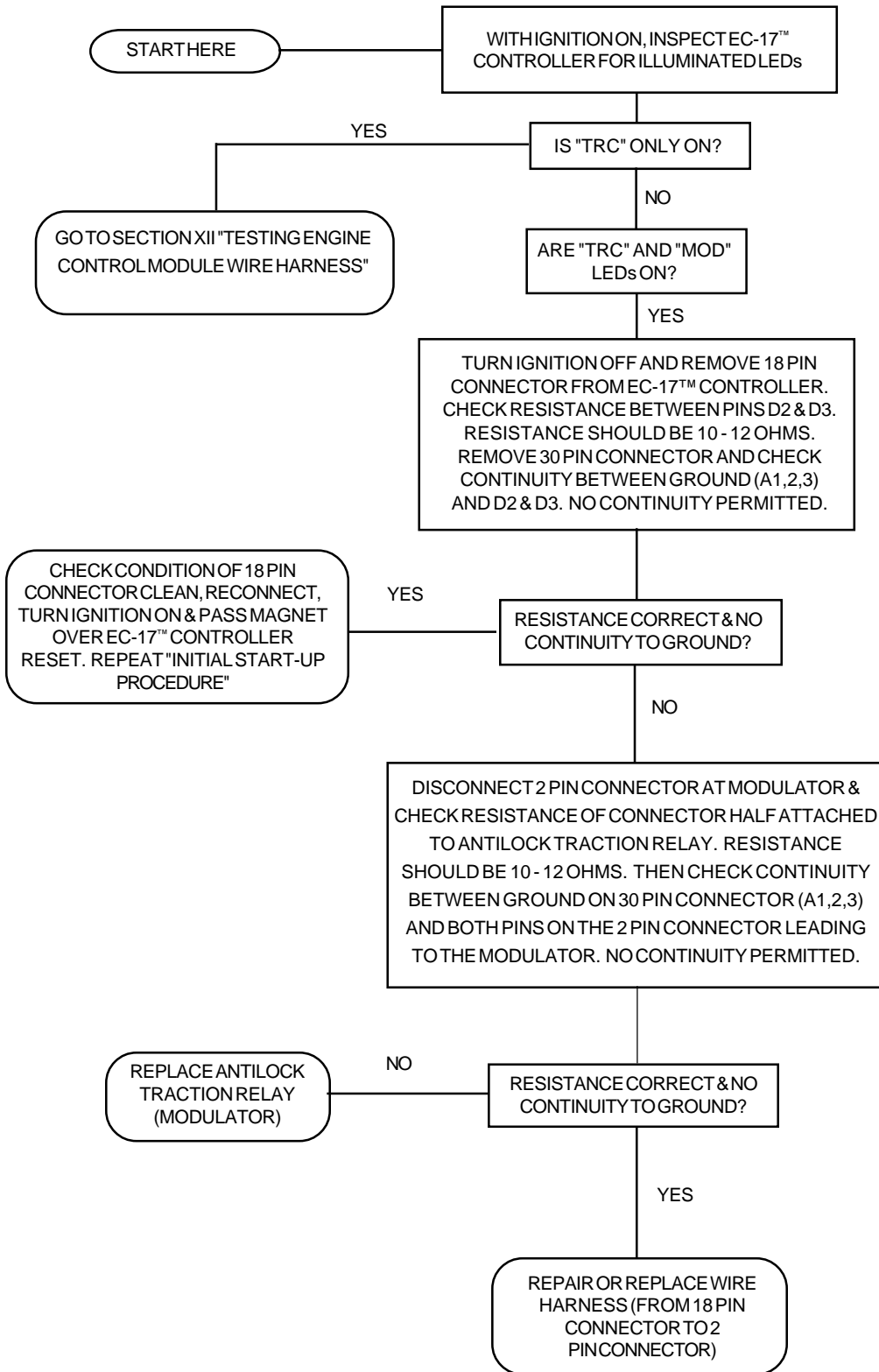
SECTION IX - TESTING FOR FALSE INDICATION CAUSED BY WHEEL SPEED COMPONENTS



SECTION X - TESTING TRACTION CONTROL DASH LAMP



SECTION XI - TESTING TRACTION CONTROL MODULATOR



SECTION XII - TESTING ENGINE CONTROL MODULE WIRE HARNESS

