

ALLISON HYBRID

OPERATOR INFORMATION



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Operator Information

Operational Characteristics

- Smooth acceleration.
- Electronic Push Button Shift Selector (PBSS) enables:
 - *Range selection.*
 - *Regenerative braking level selection.*
 - *Diagnostic information display.*
- Throttle control.
 - *Engine RPM is not directly related to throttle position.*
 - *Engine RPM increases slowly during initial acceleration.*
 - *Engine RPM may increase during deceleration to maximize exhaust brake efficiency.*



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Operator Information

Operational Characteristics (cont'd)

- Idle Speed.
 - *Varies based on ESS State of Charge (SOC) and temperature of sump fluid.*
- Smooth engine shutdown.



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ALLISON HYBRID

RESOURCES: Operational Characteristics

EP SYSTEM™ OPERATIONAL CHARACTERISTICS

An operator of a vehicle equipped with the EP System™ hybrid drive can expect smooth acceleration from the two speed (*two mode*) transmission. There is one synchronous zero energy shift between the two modes. The vehicle controls are consistent with other Allison Transmission products. The EP System™ uses an electronic push button shift selector (PBSS) for range selection and operation of additional functions such as regenerative braking levels. The PBSS contains a single digit display window which shows the currently selected range. This display is also used to read diagnostic information from the system



The EP 40/50 System™ expends energy to propel the vehicle and recovers a major portion of that expended energy with regenerative braking. During regenerative braking the EV Drive™ motors are electrically switched from motor operation to generator operation. With the motor now a generator, electrical energy is routed from the generator/motor through the DPIM to the ESS. Regenerative braking occurs whenever the throttle is not depressed and increases with the application of the service brakes. Regenerative braking performs the same function as an automatically applied hydraulic retarder on a conventional Allison transmission by slowing the vehicle driveline and reducing the need for the driver to use the service brakes.

Regenerative braking is automatically reduced when the anti-lock braking system (ABS) signals wheel slip or lock up conditions. This allows the driver to use the service brakes to control the vehicle in a slide condition. If the vehicle is equipped with automatic traction control (ATC), acceleration is automatically reduced when ATC signals wheel slip conditions, allowing the vehicle to regain traction.

PUSH BUTTON SHIFT SELECTOR

The PBSS used in the EP System™ is consistent with the electronic shift selectors in other Allison Transmission products. The PBSS includes 6 total buttons, R, N, D, Mode, an Up Arrow and a Down Arrow. There is also a single digit display window located at the top center of the selector used for displaying range and diagnostic information. D stands for Drive and requests forward operation of the vehicle. When the forward range is successfully obtained, the display window will show F. N stands for Neutral and requests Neutral operation. The display will show N when neutral is successfully attained. R is for Reverse and requests Reverse operation of the vehicle. The display will show R when Reverse range is successfully attained.



If the PBSS display is flashing it is signaling the operator that the particular range was not attained. To correct this condition, select Neutral with the N button and attempt to reselect the desired range. If the range is still not successfully attained, ensure that all vehicle interlocks are closed and the service brake is being applied before and during range selection.

ACTIVE ENGINE STOP

When the ignition key is turned off and a system shutdown is initiated, the engine is actively brought to zero speed. The reason for the quick engine shutdown is to reduce torsional activity from the engine being introduced into the EV Drive™. During a limp home or fault condition, Active Engine Stop may be disabled.



ALLISON HYBRID

RESOURCES: Operating Features



OPERATING FEATURES

TURNING ON/OFF THE VEHICLE

Vehicle on/off procedures are the same as with a conventional engine-transmission equipped vehicle. Select **N** (Neutral) and apply the parking brake before turning off the vehicle.

COLD ENGINE IDLE SPEED

At sump temperature below 32°F (0°C), the system will automatically command the engine speed to a high idle condition to increase fluid temperature.

FAST ENGINE SHUTDOWN

At ignition key **OFF**, the E^V Drive™ will actively stop the engine, resulting in a controlled, fast, engine shutdown.

ENGINE HIGH-IDLE

Neutral-to-Range (Forward and Reverse) operation can be made with engine in high-idle state.

DIRECTION CHANGES

All direction changes must be made with the service brake applied and zero road speed. Range changes can be made **D** (Forward) to **R** (Reverse) without first selecting **N** (Neutral). Requiring range changes through **N** (Neutral) is a calibrateable feature. This feature can only be modified with the Allison DOC™ diagnostic tool.

ACCELERATOR CONTROL

As you increase throttle application, you will experience a smooth, steady increase in road speed without discernible changes in gear ratios. Engine speed is not directly proportional to vehicle speed or driver-requested acceleration.

SLOWING AND STOPPING YOUR VEHICLE

Slow and stop your vehicle as you would if you were driving with an automatic transmission. All E^V Drive™ functions, regenerative braking, etc., occur automatically and are transparent to the driver.



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OPERATOR INFORMATION

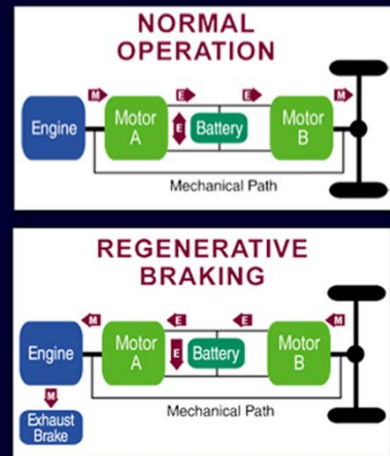


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Push Button Shift Selector Operation

- Range selection and shift selector operation is consistent with other Allison Transmission products.
 - Drive, Neutral and Reverse buttons.
 - Flashing display indicates the desired range was not attained.
 - Select Neutral and re-attempt the shift.



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OPERATOR INFORMATION



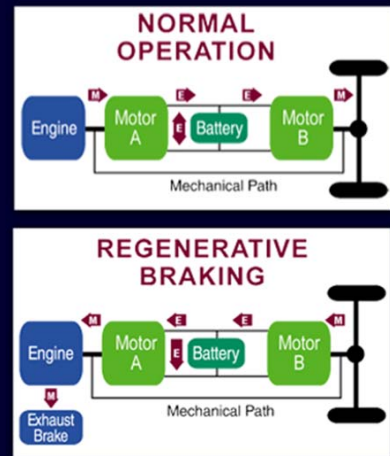
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Operator Information

Push Button Shift Selector Operation (cont'd)

Regenerative Braking.

- Initiated by closed throttle.
- Service brake input increases level of regenerative braking.
- Slows the driveline and creates energy which is stored by the ESS.
- Up and down arrow buttons increase/decrease regenerative braking level.
- Operation feels similar to traditional transmission output retarder.



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RESOURCES: PBBS Operation

PUSH BUTTON SHIFT SELECTOR

The PBSS used in the EP System™ is consistent with the electronic shift selectors in other Allison Transmission products. The PBSS includes 6 total buttons, R, N, D, Mode, an Up Arrow and a Down Arrow. There is also a single digit display window located at the top center of the selector used for displaying range and diagnostic information. D stands for Drive and requests forward operation of the vehicle. When the forward range is successfully obtained, the display window will show F. N stands for Neutral and requests Neutral operation. The display will show N when neutral is successfully attained. R is for Reverse and requests Reverse operation of the vehicle. The display will show R when Reverse range is successfully attained.



If the PBSS display is flashing it is signaling the operator that the particular range was not attained. To correct this condition, select Neutral with the N button and attempt to reselect the desired range. If the range is still not successfully attained, ensure that all vehicle interlocks are closed and the service brake is being applied before and during range selection.

REGENERATIVE BRAKING

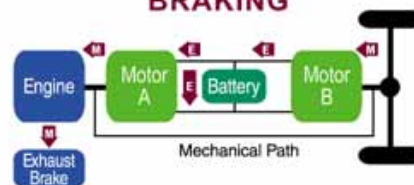
As regenerative braking is initiated by a closed throttle position, the driveline is slowed. As the service brake pedal is depressed, the level of regenerative braking is increased. The regenerative braking process is seamlessly modulated with the engine exhaust brake to provide a smooth and consistent braking feel.

REGENERATIVE BRAKING CONTROL

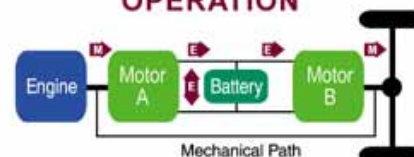
The level of regenerative braking can be adjusted with the PBSS. The down arrow increases the level and the up arrow decreases the level. An "L" is shown in the PBSS display window indicating that Low mode for regenerative braking is set. This is the maximum level of regenerative braking available. An "F" is displayed to indicate the default level of regenerative braking is set.

The level of regenerative braking has no effect on forward speed of the vehicle. Any changes to the regenerative braking levels are reset to default at the next ignition cycle.

REGENERATIVE BRAKING



NORMAL OPERATION



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RESOURCES: Electronic Control System

NOTE: This resource link has multiple pages and information changes frequently. Reference the source document for complete, current information.

ELECTRONIC CONTROL SYSTEM~

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ELECTRIC DRIVES™

PUSHBUTTON SHIFT SELECTOR (PBSS)

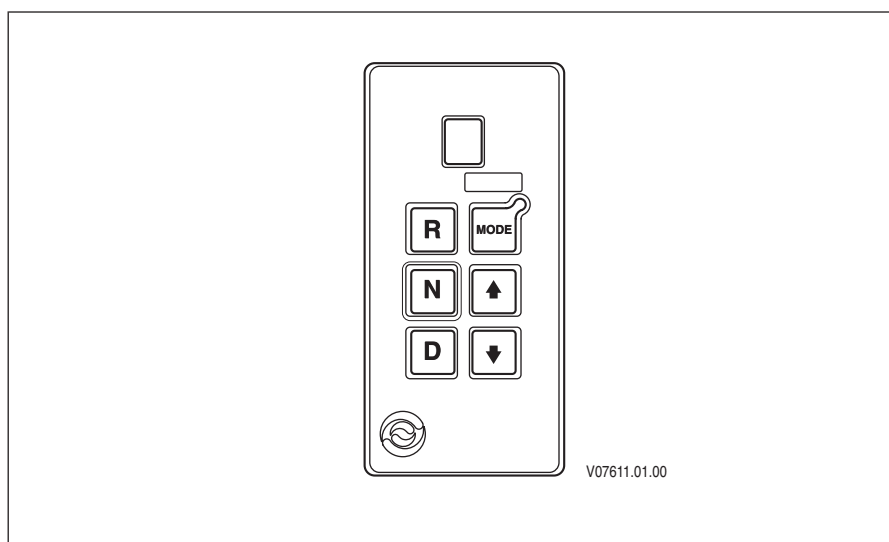


Figure 11. Pushbutton Shift Selector

The pushbutton shift selector (PBSS) commands direction of operation rather than selecting an operating range. The direction of operation displays on the shift selector.

Shift selector directional buttons are:

- D**—Forward, commands forward vehicle movement, **F** displays
- N**—Neutral, commands neutral, **N** displays, no vehicle movement
- R**—Reverse, commands rearward vehicle movement, **R** displays

UP AND DOWN ARROW BUTTONS

Pressing the ↓ (Down) arrow button while in forward operation commands the E^P 40/50 System™ to increase the regenerative braking effect. Regenerative braking provides the same braking function as a hydraulic retarder in a



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Operator Information

Engine Starting Sequence

- Vehicle startup occurs in the following order:
 - Turn ignition on with master run switch
 - Allow vehicle systems to wake up.
 - “Wait to Start” lamp goes out when system wakes up.
 - Press and hold the engine start button.
 - A one second delay occurs before engine begins to crank.
- The drive unit is used to crank the engine.



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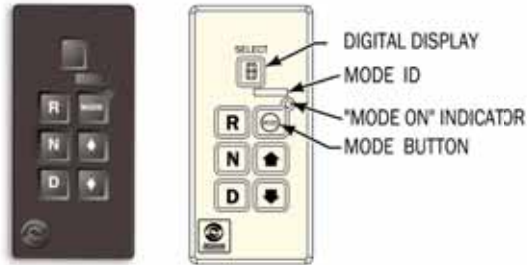
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RESOURCES: Engine Starting Sequence

ENGINE STARTING SEQUENCE

The vehicle startup sequence should occur in the following order:

- Turn the ignition on using the master run switch.
- Allow the vehicle systems to wake up (the completed wake up cycle is indicated by the "Wait to Start" lamp going out).
- Press and hold the engine start button.



Motors in the E^V Drive™ unit are used to rotate the engine for starting. Expect an approximate one second delay after pressing the engine start button before the engine begins to crank. Prior to each startup cycle, E^V Drive™ motor diagnostics are performed on both Motor A and Motor B. During warm weather operations (*greater than 0 degrees C, 32 degrees F*) engine cranking will last approximately 1-2 seconds. During cold weather conditions (*a sump temperature less than 0 degrees C, 32 degrees F*) the E^P System™ will automatically initiate a cold start sequence. This sequence provides for a longer engine cranking time of 3-4 seconds to improve diesel fuel ignition.



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Operator Information

Engine Crank Inhibits

- Engine Crank Inhibits protect the system.

- Normal start.
- Cold weather start.
- Time-out abort.
- Low RPM abort
- Low vehicle battery.
- ESS low voltage.
- DPIM low voltage.

Normal Start

Cold Weather Start

Time-Out Abort

Low RPM Abort

Low Vehicle Battery

ESS Low Voltage

DPIM Low Voltage

Active when vehicle batteries and ESS voltages meet predetermined requirements and transmission fluid is above 32 degrees Fahrenheit



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ALLISON HYBRID

RESOURCES: Operating Features



OPERATING FEATURES

TURNING ON/OFF THE VEHICLE

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COLD ENGINE IDLE SPEED

At sump temperature below 32°F (0°C), the system will automatically command the engine speed to a high idle condition to increase fluid temperature.

FAST ENGINE SHUTDOWN

At ignition key **OFF**, the E^V Drive™ will actively stop the engine, resulting in a controlled, fast, engine shutdown.

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DIRECTION CHANGES

All direction changes must be made with the service brake applied and zero road speed. Range changes can be made **D** (Forward) to **R** (Reverse) without first selecting **N** (Neutral). Requiring range changes through **N** (Neutral) is a calibrateable feature. This feature can only be modified with the Allison DOC™ diagnostic tool.

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SLOWING AND STOPPING YOUR VEHICLE

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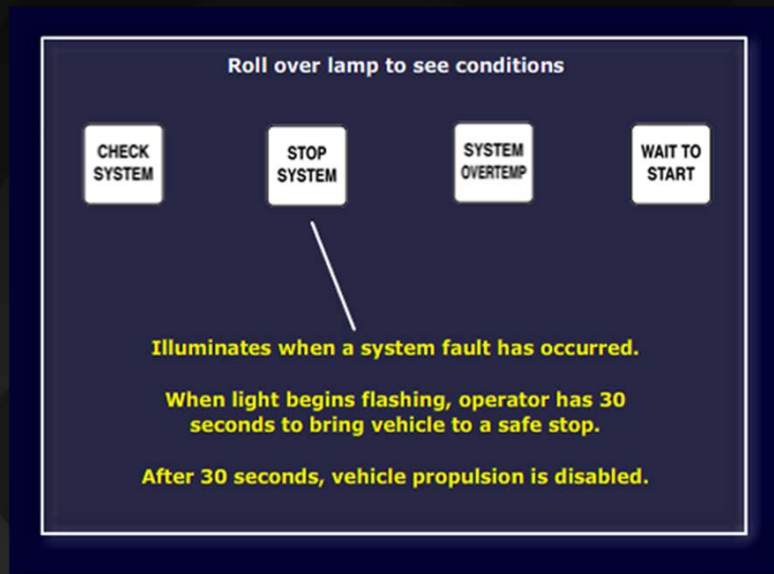
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Operator Information

Indicator Lamps

- Four Malfunction Indicator Lamps are used in the system:

- Check System.*
- Stop System.*
- System Overtemp.*
- Wait To Start.*



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RESOURCES: Indicator Lamps

DASH INDICATOR LIGHTS

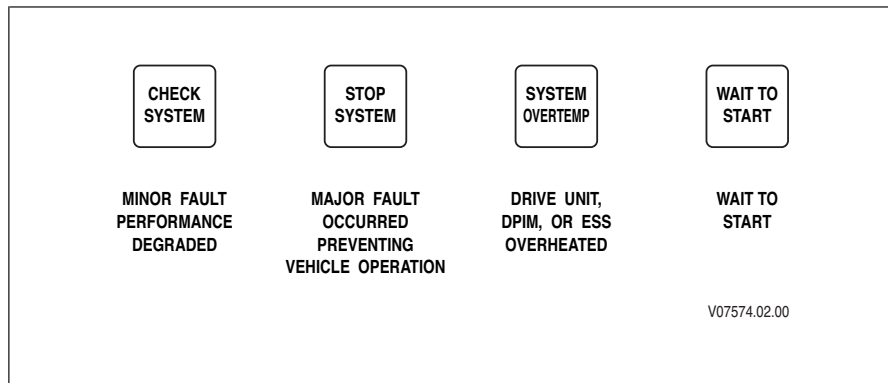


Figure 12. Warning Lights

WAIT TO START. The **WAIT TO START** light is located on the dash panel. This indicator notifies the operator that the vehicle system is not ready to start. The light is extinguished when the vehicle systems are ready for start-up. If the indicator remains illuminated, check the PBSS for diagnostic codes related to the E^P 40/50 System™. Continued illumination of this indicator can also indicate vehicle system inhibits.

SYSTEM OVERTEMP. The **SYSTEM OVERTEMP** warning light is located on the dash panel and alerts the operator when any of the E^P 40/50 System™ components has reached a thermal limit. Overtemp faults result in reduced performance or a disabled propulsion system condition. Check the PBSS for specific diagnostic trouble codes.

CHECK SYSTEM. The **CHECK SYSTEM** warning light is located on the dash panel and alerts the operator that an E^P 40/50 System™ fault has occurred. Vehicle propulsion will not be disabled when **CHECK SYSTEM** is illuminated. Immediately return the vehicle for service. If a fault occurs a Diagnostic Trouble Code (DTC) for that fault is logged into diagnostic system memory. Check the PBSS for specific diagnostic trouble codes.

STOP SYSTEM. The **STOP SYSTEM** warning light is located on the dash panel and alerts the operator that a severe E^P 40/50 System™ fault has occurred. Faults of this nature automatically disable the propulsion system. The driver will have approximately 30 seconds to move the vehicle to a safe location before the E^P 40/50 System™ is disabled. During this time, the **STOP SYSTEM** light will flash. Stop the vehicle immediately and remove it from service. If a fault occurs a DTC for that fault is logged into diagnostic system memory. Check the PBSS for specific DTCs.



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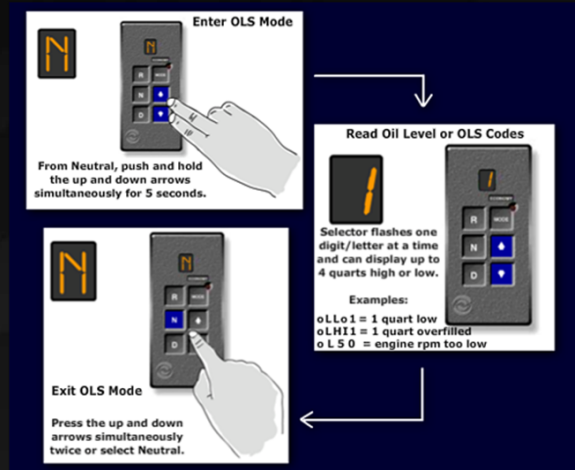


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Operator Information

Oil Level Sensor

- The drive unit is equipped with an Oil Level Sensor in the sump.
- Use the PBSS to access OLS information.
 - *Enter OLS mode.*
 - Hold both arrows down simultaneously for 5 seconds.
 - *Read OLS codes.*
 - PBSS display window shows one character at a time to indicate status.
 - *Exit OLS mode.*
 - Press both arrows simultaneously twice.
- Specific conditions must be met for the OLS to provide accurate readings.



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RESOURCES:

Fluid Check Procedures & OLS Codes

E^V DRIVE™ FLUID LEVEL CHECK PROCEDURE

The E^V Drive™ is equipped with an electronic Oil Level Sensor, or OLS. The pushbutton selector can be used to read the OLS. To perform this check, use the following procedure on the PBSS:



- With the vehicle in Neutral, depress the up and down arrows one time simultaneously to put the system into the Oil Level Mode.
- The display window on the PBSS will count down from 8 to one and then display the status of the fluid level.
- If the level is okay the characters o-L-o-K display.
- If the level is not ok or some other fault condition is present different codes will be displayed.

The following conditions must exist for the OLS to provide an accurate reading:

- Sump temperature must be greater than 20 degrees Celsius (68 degrees Fahrenheit).
- Engine idle speed less than 900 rpm.
- Vehicle in Neutral range.
- Output speed of zero rpm.

OLS CODES

- o,L,o,k: Fluid level is correct.
- o,L,L,o,1: Fluid level is one quart low.
- o,L,H,I,1: Fluid level is one quart high.
- o,L,-,5,0: Engine rpm is too low.
- o,L,-,5,9: Engine rpm is too high.
- o,L,-,6,5: Neutral range is not selected.
- o,L,-,7,9: Sump fluid temperature is too high.
- o,L,-,8,9: Output shaft rotation is detected.
- o,L,-,9,5: Oil Level Sensor failure.



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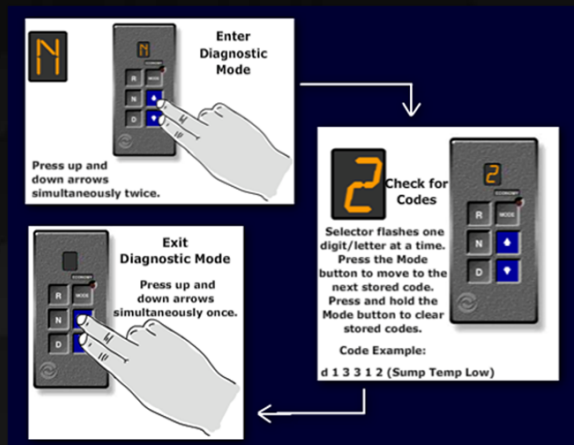


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Diagnostic Mode

- The system provides self-diagnostic feedback using 4-digit Diagnostic Trouble Codes (DTCs).
 - Enter Diagnostic mode.
 - Press both arrow keys simultaneously twice..
 - Check for codes.
 - Press Mode button to scroll through codes.
 - Exit Diagnostic mode.
 - Press both arrow keys simultaneously.
- DTC structure is common with other Allison Product Families.



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RESOURCES: PBBS Diagnostic Mode



NOTE: This resource link has multiple pages and information changes frequently. Reference the source document for complete, current information.



ELECTRONIC CONTROL SYSTEM

PUSHBUTTON SHIFT SELECTOR (PBSS)

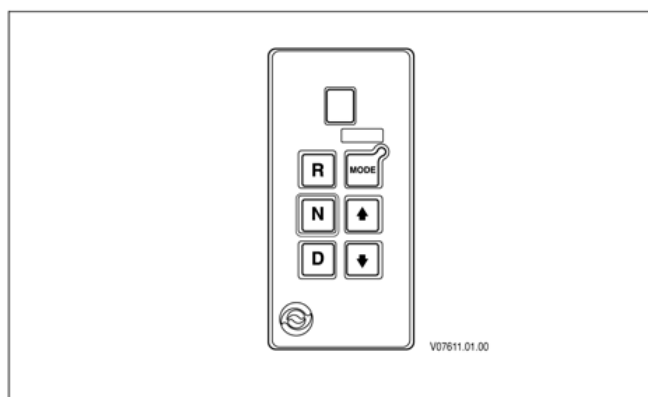


Figure 11. Pushbutton Shift Selector

DIAGNOSIS

Continued illumination of the **CHECK SYSTEM** light during vehicle operation (not start-up) indicates the TCM has signaled a diagnostic code. Poor performance may activate a code without illuminating the **CHECK SYSTEM** light. Up to nine diagnostic codes can be recorded. Diagnostic codes can be read and cleared by two methods: using the shift selector or using the Allison DOC™ For PC (AED) diagnostic tool. Basic information on code reading, code clearing, and troubleshooting is covered in the **DIAGNOSTIC CODES** section. More detailed information is available in the Troubleshooting Manual (TS3715EN).

DIAGNOSTIC CODES

Diagnostic codes are numerical indications relating to a malfunction in transmission operation. Each code consists of a two-digit main code and a two-digit subcode.

These codes are logged in a list in the TCM memory with the most recent code listed first. A maximum of nine codes (numbered d1–d9) may be listed in memory at one time. As codes are added, the oldest non-active code is dropped from the list. If all codes are active, the code with the lowest priority that is not included on the severity list is dropped from the list. Access to the diagnostic codes and code information is through the pushbutton shift selector or the diagnostic tool.

The TCM separately stores the active and historical (non-active) codes. An active code is any code that is current in the TCM decision-making process. Historical codes are codes that are retained in the TCM's memory and will not necessarily affect the ECU decision-making process. Historical codes are useful in determining if a problem is isolated, is intermittent, or results from a previous malfunction.



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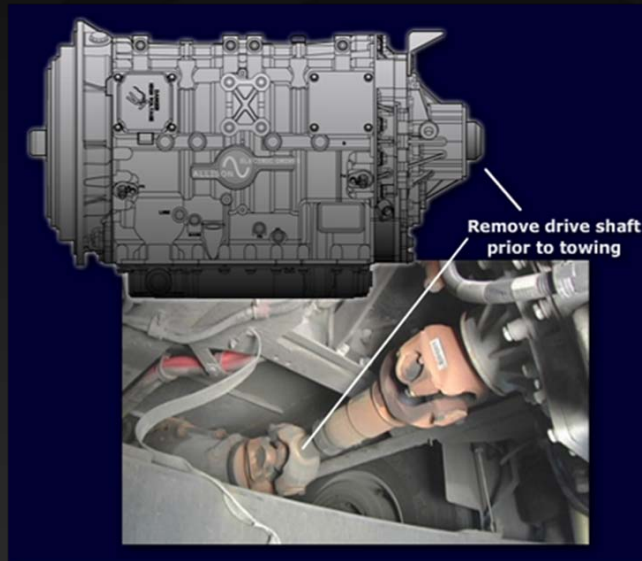


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Towing

- Towing precautions must be taken to avoid damage to the drive unit.
 - *Remove axles and/or drive shaft prior to towing the vehicle.*



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RESOURCES: Towing Requirements

TOWING REQUIREMENTS

Operators of a vehicle using the E^P System™ must be aware of the towing requirements of a disabled vehicle. The axle or drive shaft must be removed prior to towing the vehicle or damage to the E^V Drive™ will occur. This is due to the fact that the gears and bearings inside of the E^V Drive™ are lubricated using a positive pressure pump that operates under rotational power from the engine. When the engine is not running, adequate lubrication is not provided to the E^V Drive™ components. If the driveline or axle is not removed prior to towing, the E^V Drive™ will be rotated as a result of the vehicle's drive wheels turning the driveline that is attached to the output yoke of the E^V Drive™. Therefore, damage will occur to the E^V Drive™ from inadequate lubrication of the internal components.

