

Endurant XD Series PTO Installation and Body Integration Guide TRIG2620EN-US

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EXD-xxF118D
EXDP-xxF118D



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Important Information

This symbol is used throughout this manual to call attention to critical information where failure to adhere to safety specifications may result in personal injury and/or component damage.

Departure from the instructions, choice of tools, material or recommended parts mentioned in this publication may jeopardize safety.

Safety Requirements:

Safety related requirements placed on the vehicle system by the transmission. Failure to comply may disable key and/or redundant safety features of the transmission system.



DANGER: Failure to follow indicated procedures will result in death or serious injury.



WARNING: Failure to follow indicated procedures and/or safety requirements could result in death or serious injury.



CAUTION: Failure to follow indicated procedures could result in minor or moderate injury.

NOTICE: Failure to follow indicated procedures could result in damage to the transmission system.



WARNING: While working on a vehicle, do not modify transmission components or systems. Modification (altering, substituting, relocating) of transmission components may result in major vehicle component damage, severe injury or death.

This publication has been assembled to assist the original equipment manufacturer (OEM) with proper design integration, handling and assembly of Endurant XD Series transmissions. For additional information such as transmission operation, troubleshooting and warranty information, please see the Other Useful Publications section in this manual.

The Endurant XD system is designed to operate correctly and safely when the requirements in this installation guide are met, in particular unintended or incorrect system operation could occur if requirements marked as a safety requirement are not complied with.

Transmissions installed at OEM facilities shall meet all requirements as identified in the Application Guidelines TRAG2600 and be approved by Eaton Application Engineering. Contact your OEM Application Engineering department or Eaton Application Engineering for the proper Application Approval Form. All applications shall be submitted for approval.

Endurant XD Series transmissions are only compatible with engines as certified by Eaton Cummins Automated Transmission Technologies. For specific engine information, please contact the engine manufacturer.

Failure to adhere to installation requirements or any handling and installation requirements may affect transmission performance and/or warranty coverage.

Important Notice

Any reference to brand names in this publication is made as an example of the types of tools and materials recommended for use and should not be considered an endorsement. Equivalents may be used.

Every effort has been made to ensure the accuracy of the information contained in this manual. However, Eaton and Eaton Cummins Automated Transmission Technologies makes no warranty, either expressed or implied, based on the information provided and reserves the right to discontinue or modify models and/or procedures and to change specifications at any time without notice.

The vehicle OEM shall be responsible for producing parts that meet the requirements of this document.

PTO Configurations by Model - Endurant XD Series

PTO Availability

	Transmission Mounted (Input Shaft Driven) PTO	Split Shaft (Output Shaft Driven) PTO
Endurant XD	8-bolt and 4-bolt Standard	Not Approved
Endurant XD Pro	8-bolt and 4-bolt Standard	Yes

Heavy-Duty Automated - Endurant XD Series

Transmission Model	SAE 8-Bolt	SAE 8-Bolt Gear Info.	SAE 8-Bolt Speed	Rear PTO	Rear PTO Speed	Transmission Power Limit for PTO Use (HP /TQ)
EXD-16F118D	Yes ¹	46T 3. MODULE 20 DEB PA	111% Opposite of Engine	Yes ²	111% Opposite of Engine	160 HP/610 lb-ft ³
EXD-18F118D						
EXDP-16F118D						
EXDP-18F118D						
EXDP-20F118D						
PXD-16F118D						
PXD-18F118D						
PXDP-16F118D						
PXDP-18F118D						

Note: (1) - Elastomer controlled squeeze seal required at PTO Transmission mounting surface. SAE 8-bolt PTO opening is standard on all Endurant XD Series transmissions.

Note: (2) - DIN 5462 80x80 and 121x111 mounting. 35 tooth external spline. Rear PTO is standard on all Endurant XD Series Transmissions.

Note: (3) - PTO HP/TQ rating is for either the 8-bolt bottom PTO, the 4-bolt rear PTO, or the combined load from both PTOs if used simultaneously.

Note: Use of "HOT SHIFT" PTO not allowed for Endurant model transmissions.

PTO Locations - Endurant XD Series

The Endurant XD Series transmissions come standard with two PTO locations.

When designing your system, account for these locations which are different from previous Eaton/Fuller transmissions as well as the Endurant HD 12-Speed transmission.

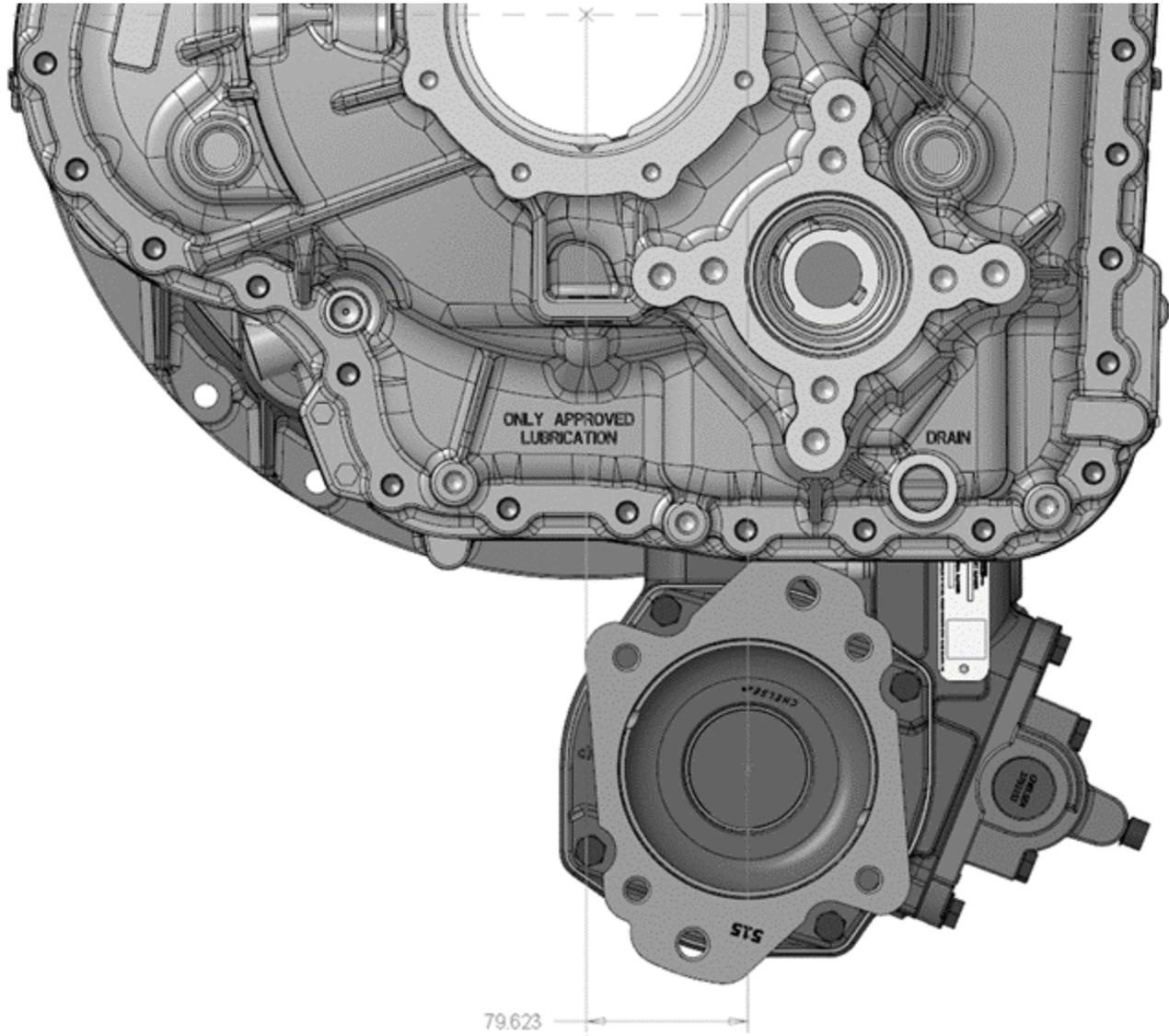


Figure 1 - Endurant XD Rear View

PTO Drive Gear

The Endurant XD Series transmissions use a unique PTO drive gear which is different from the gear used with the Eaton/Fuller and Endurant HD Series transmissions.

Only use a PTO that has been specified for the Eaton-Cummins Endurant XD Transmission.

Contact PTO manufacturer with the information in the chart above to verify the correct PTO for the Endurant XD Transmission.

NOTICE: Failure to use the correct PTO will result in transmission damage.



Figure 2 - PTO example for Endurant XD Series Transmission

Automated PTO Control Interface - Endurant Series

The Endurant XD Series transmissions use an automated PTO interface to provide seamless engagement and operation from inside the cab or remotely from outside the cab.

The automated interface also protects the PTO from improper engagements that can damage the PTO.

How this works:

- The transmission will receive a “PTO request” signal from the PTO switch requesting PTO engagement and the transmission opens the clutch.
- The transmission will supply the “PTO consent” output to energize the PTO air solenoid and engage the PTO.
- When the PTO is engaged, the engagement switch located on the PTO sends a “PTO Confirmation” signal back to the transmission confirming its engagement and the transmission closes the clutch.

Note: Refer to Endurant XD Series Automated Transmission Driver Instructions (TRDR0960) for driver instructions on PTO operation.

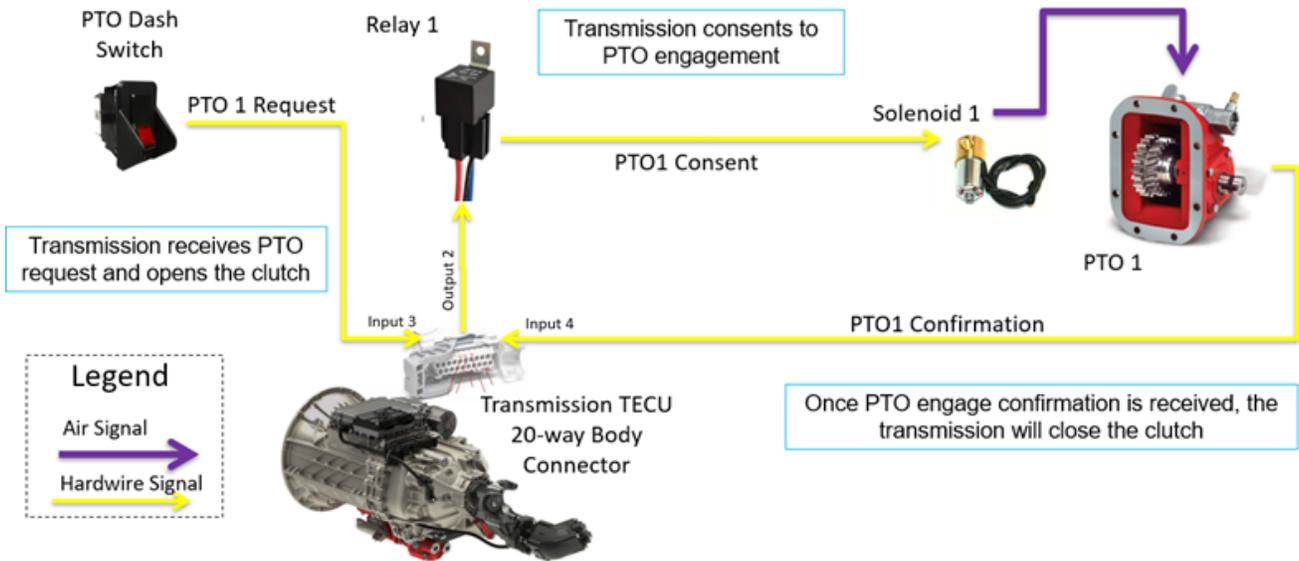


Figure 3 - PTO Automated Control - PTO 1 Hardwired Example

Split-Shaft (Output Shaft Driven) PTO Control

The operation sequence for a split-shaft PTO is similar to a transmission mounted PTO, including a request, consent, and confirmation before operation can commence.

How this works:

- Vehicle must be parked (stationary) and the transmission in neutral.
- The transmission receives a “SSPTO request” input signal from the SSPTO switch, requesting SSPTO mode.
- The transmission turns on the “SSPTO engagement consent” signal indicating the transmission has consented for the transfer case to be engaged. If hardwired, the relay connected to this output may be used in conjunction with other body interface interlocks to allow transfer case engagement, but it is important that a load (i.e. relay coil) be connected to this output to prevent a fault.
- When the transmission indicates a consent to engage, the transfer can be engaged and a “SSPTO Engagement Confirmation” signal is received by the transmission to indicate the transfer case is now engaged (driveline is dis-engaged).
- Once the transmission has received the Switch Request and the Engagement Confirmation inputs, and no fault is present on the Consent Output (if hardwired), the transmission is ready for SSPTO mode.
- To activate SSPTO Mode, depress the brake pedal and select Drive using the shift selector in the cab. This commands the transmission to engage the start gear programmed for SSPTO mode and displays this in the gear display (16th is default). The transmission will also automatically switch to manual mode to hold the transmission into its current gear.
- To close the clutch and begin spinning the output shaft, simply release the brake pedal. To open the clutch and stop the output shaft, depress the brake pedal. Note that engine speed must be at idle speed before the clutch will open when the brake is depressed (engine PTO mode must be canceled).
- Once the clutch is closed, the engine speed can be raised using the engine PTO controls. The brake pedal has no effect on the clutch once the engine is raised off idle. This is to prevent unintended interruption if the brake pedal is accidentally depressed.

Note: The engine speed MUST be returned to idle in order to open the clutch and stop the output shaft.

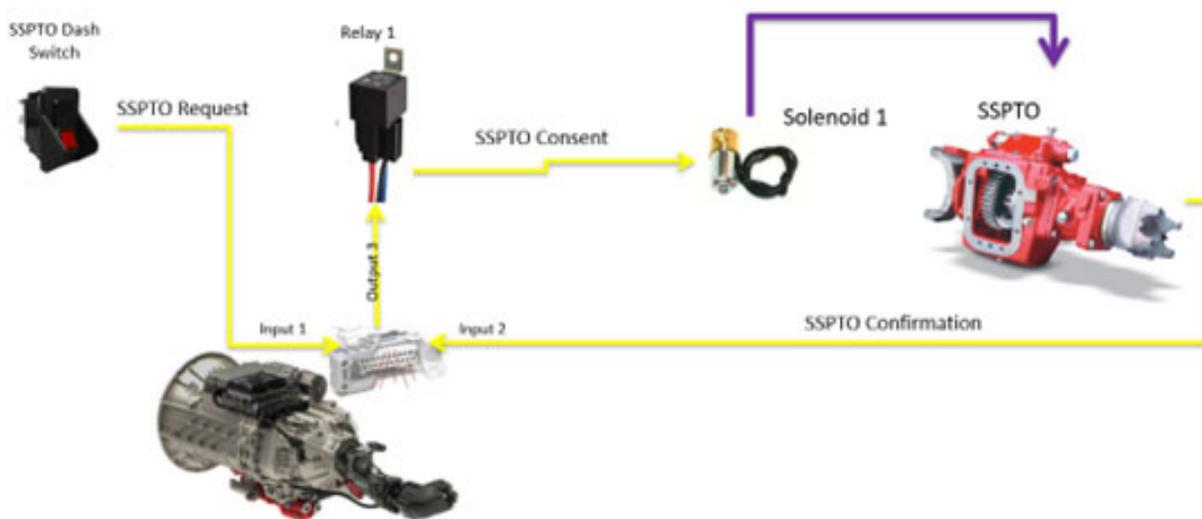


Figure 4 - SSPTO Control - Basic Hardwired Example

PTO Control Using J1939 - Endurant XD Series

The Endurant transmission uses the SAE J1939 Power Take Off Drive Engagement (PTODE) message for its PTO J1939 Control.

OEM PTO Switch Pre-Wire Kit (transmission mounted PTOs)

Most vehicle OEM's offer a PTO pre-wire kit that includes a multiplexed (LIN) dash switch, air solenoid, and associated wiring to control a PTO using the vehicle control module. This setup uses the vehicle's J1939 data link for all PTO control between the vehicle control module and the transmission.

When using an OEM pre-wire kit, ensure the PTO option is configured for J1939 Control Only.

If using two PTOs, make sure each PTO switch is configured for either PTO1 or PTO2 and the transmission is configured for PTO1 and PTO2 J1939 Control Only. Each PTO uses a different J1939 control message, so it is important to ensure they are configured properly. Some OEMs require an additional chassis module for a second PTO. Consult your OEM for more information on installing two PTOs using the OEM dash switches.

All OEM PTO pre-wire kits require a confirmation engagement wire to be connected between the ball switch on the PTO and the chassis/body module. This allows the body module to send the engagement status to the transmission over the J1939 data link. If this wire is not connected, this can result in the PTO not staying engaged and may set a fault in the transmission.

OEM Pump Mode Switch Pre-Wire Kit (Split-Shaft PTO)

A Pump Mode switch is used to control a Split-Shaft PTO (SSPTO) using the vehicle control module. The pump mode switch uses PTODE messages over the J1939 data link that are unique to an Output Shaft (SSPTO) and different from those used for PTO1 and PTO2. A Pump Mode switch pre-wire kit is similar to that used for a transmission mounted PTO which will include a multiplexed (LIN) dash switch, air solenoid, and associated wiring to control the SSPTO using the vehicle control module/body controller.

When using a Pump Mode pre-wire kit, ensure the SSPTO option is configured for J1939 Control Only.

The OEM Pump Mode Switch kit requires a confirmation engagement wire be connected to the chassis/body module so the engagement status of the transfer case can be sent to the transmission over the J1939 data link. If this wire is not connected, the transmission will not enter SSPTO Mode when Drive Mode is selected and the transmission will set a fault.

Consult your OEM if the Pump Mode switch complies with the full PTODE message (Request, Consent, Engage Status) as described later in this document.

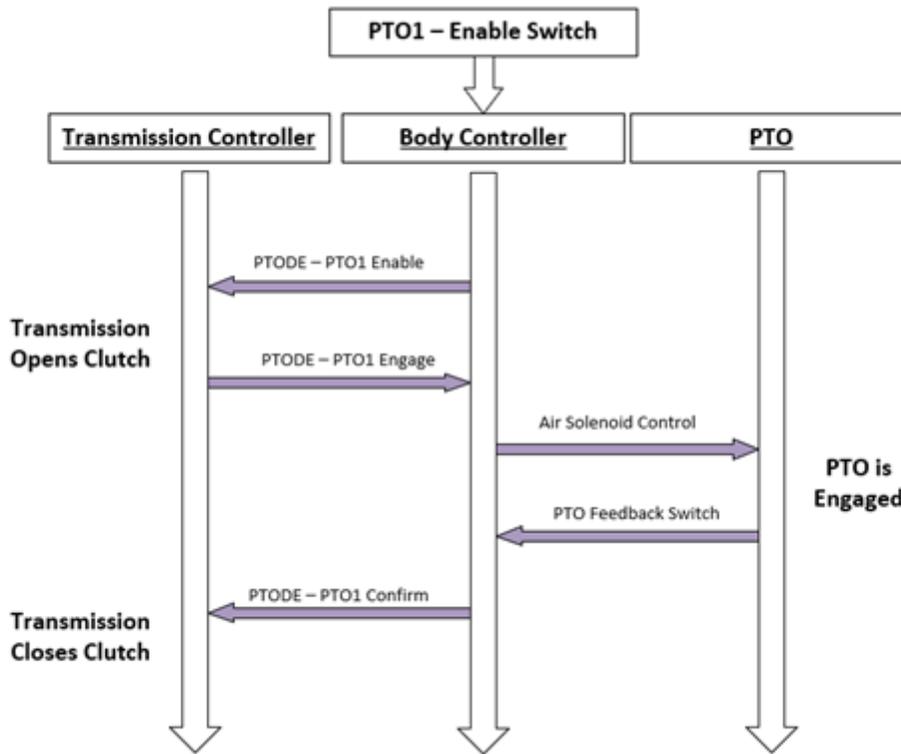
J1939 Body Control System

This section is intended to guide a body builder when creating a custom body control system that can interface with the transmission for PTO or Split-Shaft PTO control using the SAE PTODE message over the J1939 datalink. This would be used when it is not desired or possible to use the OEM pre-wire kit.

It is assumed the body builder has some knowledge on how to interface with the vehicle J1939 data link and the use of the SAE J1939 PTODE control message used for PTO control. Refer to the SAE J1939 Digital Annex for more information on the PTODE message.

The transmission logic for PTO control requires that the PTO Enable Switch status is first sent to the transmission and the transmission will respond with the Engagement Consent to indicate consent for PTO engagement. Once the PTO is engaged, an Engagement Status is sent back to the transmission to confirm the PTO is now fully engaged and ready for operation.

The SAE J1939 PTODE control message can be used to control PTO1, PTO2, and a Split-Shaft PTO. The body controller as well as the transmission shall both broadcast this message. The specific parameters for each of the PTO's within this message are sent from each device as follows with a value of 00b (false) to 01b (true):



PTODE Message broadcast between the Body Controller and the Transmission.

PTODE Message Parameters:

Depending on which PTO's are installed, the following SAE J1939 PTODE message parameters are used.

Input-Shaft PTO 1:

- SPN 3452 - Enable Switch - Transmission Input Shaft PTO 1
- SPN 3456 - PTO 1 Engage (Transmission Consent)
- SPN 3460 - PTO 1 Confirm (Engagement Status)

Input-Shaft PTO 2:

- SPN 3453 - Enable Switch - Transmission Input Shaft PTO 2
- SPN 3457 - PTO 2 Engage (Transmission Consent)
- SPN 3461 - PTO 2 Confirm (Engagement Status)

Output Shaft (Split-Shaft) PTO

- SPN 3454 - Enable Switch - Transmission Output Shaft PTO
- SPN 3458 - Engagement Consent - Transmission Output Shaft PTO
- SPN 3462 - Engagement Status - Transmission Output Shaft PTO

Note: Each device on the J1939 data link broadcasting the PTODE message shall only populate valid data (00 or 01) for the parameters it is controlling. All other parameters shall be sent as "Not Available".

Source Addresses:

The source address of the transmission on the J1939 data link is (03). The Endurant transmission will accept PTODE control messages from the following source addresses by default:

- Body Controller - Source Address (33/21h)
- Vehicle Management Computer - Source Address (39/27h)
- Cab Controller Primary - Source Address (49/31h)

Note: Some chassis' have more than one datalink. Consult with the vehicle OEM for guidance on properly adding a device to the primary chassis J1939 datalink.

The transmission can be configured to use PTODE parameters from a specific source address if a conflict is discovered. The following PTODE parameters can be configured independently to use a specific source address in the transmission using ServiceRanger:

- PTO 1 Enable Input
- PTO 1 Engagement Status Input
- PTO 2 Enable Input
- PTO 2 Engagement Status Input
- SSPTO Enable Input
- SSPTO Engagement Status Input

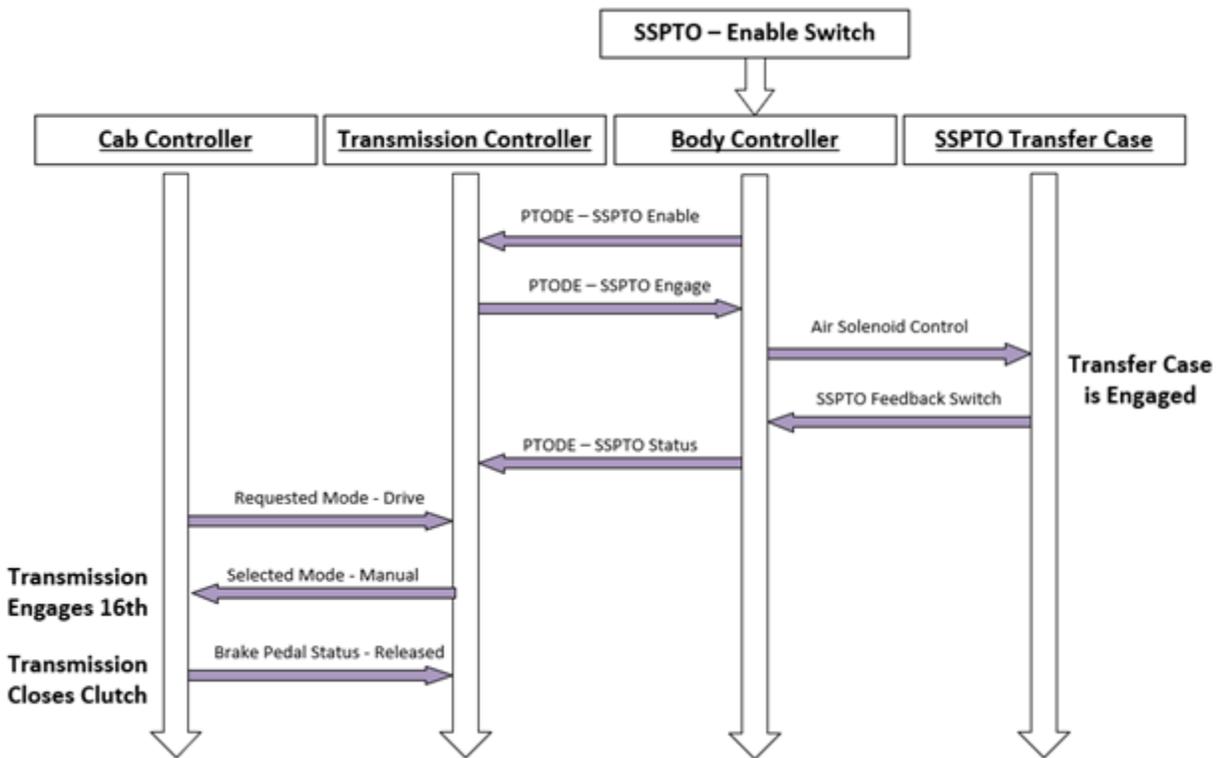
The transmission can be configured to operate two transmission mounted PTO's as well as an output shaft PTO (SSPTO) using the PTODE control message depending on the Endurant XD model. Refer to the ServiceRanger Configuration section for information on configuring the transmission for PTO control over J1939.

Transmission Split-Shaft PTO Mode over J1939

Placing the transmission into Split-Shaft PTO mode over the J1939 data link using the PTODE message is similar to engaging a transmission mounted PTO.

1. With vehicle parked and transmission in neutral, an Output Shaft (SSPTO) Enable Switch request is received by the transmission over the J1939 datalink.
2. Transmission will respond by sending an SSPTO Engagement Consent back to the controlling device to acknowledge the transmission's consent to enter SSPTO Mode.
3. The transmission will enter SSPTO Mode once it receives the SSPTO Engagement Status message from the controlling device indicating the transfer case is now engaged and the driveline has been disengaged.

Once the above steps are complete, the shift device can be placed into Drive and the transmission will enter SSPTO Mode. This will be indicated in the gear display by showing the default start gear for SSPTO Mode (16th is default). The gear display will also indicate Manual Mode.



PTO Interface

Troubleshooting J1939 PTO Control Issues

At key on, the Endurant transmission first checks its configuration. If it is configured for a J1939 controlled PTO device, it will immediately search the datalink for a device sending a PTODE message containing valid data in the above-mentioned parameters relevant for the PTO installed. Valid data is defined as any value of 00 (false) or 01 (true). Any parameters received with a value of 02 (error) or 03 (not available) will result in the transmission setting a fault if that parameter is relevant to how the transmission is configured.

For example, if the transmission is configured for PTO1 - J1939 Control Only and receives a PTODE message from the vehicle controller (SA 39) with Parameter 3452 - PTO 1 Enable Switch value set as 03, this results in the transmission setting a fault and the PTO not engaging.

In some cases, there may be multiple devices sending the PTODE message. It is important that if two or more devices are sending the PTODE message, that each device only sends valid data (00 or 01) for the PTO it is controlling. All other parameters within the PTODE message not used by the controlling device shall be sent as 03 (not available).

If the PTO dash switch is turned on and the PTO grinds or clunks, or disengages within 5 seconds of the PTO switch being enabled, this is an indication that the PTO is not configured correctly in the vehicle control module/body controller, or the engagement status is not being received by the transmission to indicate the PTO is engaged.

For a Split-Shaft PTO, if the transmission is not entering SSPTO mode after the SSPTO (Pump Mode) switch is turned on and transmission is placed in Drive, transmission may not be receiving parameter 3462 SSPTO Engagement Status as an 01 to indicate the transfer case has been engaged (driveline disengaged).

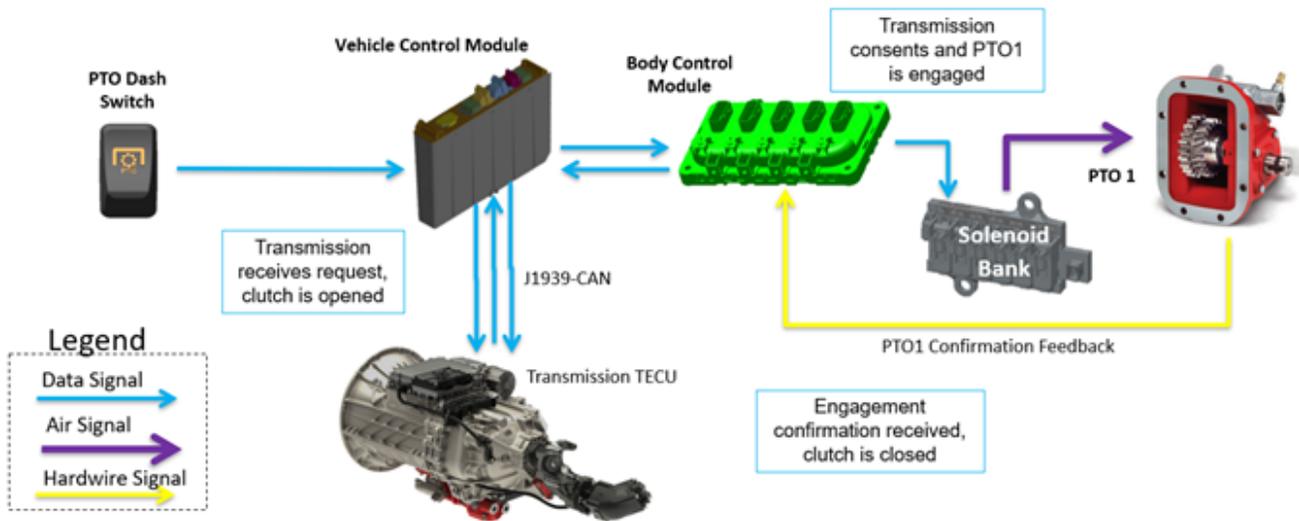


Figure 5 - Automated PTO Control - J1939 Control Example

Using ServiceRanger to monitor the PTODE messages

ServiceRanger can be used to monitor the SAE J1939 PTODE messages between the controlling device and the transmission over the J1939 data link.

1. Connect ServiceRanger to the vehicle and then Go To Data Monitor.
2. Select the Transmission PTO from the default parameter file list.

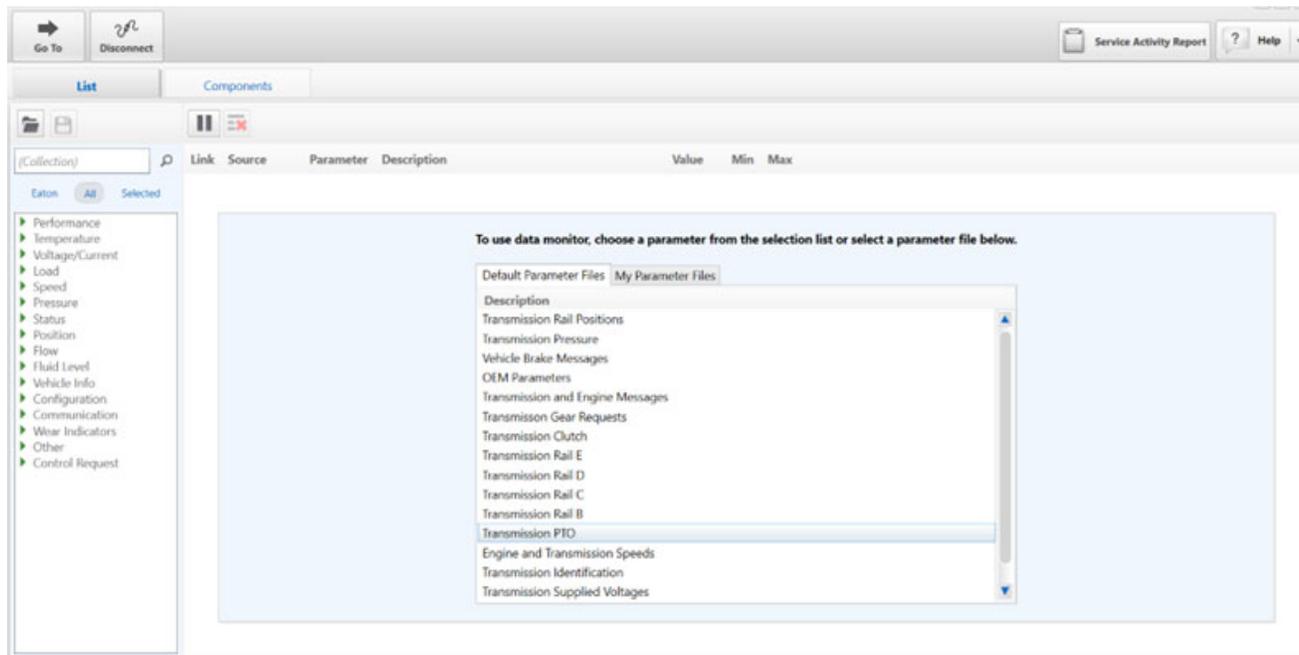


Figure 6 - ServiceRanger Screenshot

Below is a list of relevant parameters for a J1939 Controlled PTO using the PTODE message:

Input Shaft PTO1

- Parameter 3452 - Enable Switch - Transmission Input Shaft PTO 1 (PTO 1 Switch Command from Body Controller)
- Parameter 3456 - PTO 1 Engage (Transmission Consent to Engage from Transmission)
- Parameter 3460 - PTO 1 Confirm (PTO Engagement Status from Body Controller)

Input Shaft PTO2

- Parameter 3453 - Enable Switch - Transmission Input Shaft PTO 2 (PTO 2 Switch Command from Body Controller)
- Parameter 3457 - PTO 2 Engage (Transmission Consent to Engage from Transmission)
- Parameter 3461 - PTO 2 Confirm (PTO Engagement Status from Body Controller)

Output Shaft (Split-Shaft) PTO

- Parameter 3454 - Enable Switch - Transmission Output Shaft PTO (from Body Controller)
- Parameter 3458 - Engagement Consent - Transmission Output Shaft PTO (from Transmission)
- Parameter 3462 - Engagement status - Transmission Output Shaft PTO (from Body Controller)

If a parameter value is displayed as “n/a”, this indicated the controlling device is not configured to support this parameter. If any of the parameters are greyed out, this indicated the parameter is not being broadcast on the J1939 data link.

PTO Control Using Hardwired I/O - Endurant XD Series

The Endurant transmission supports the use of dedicated inputs and outputs which can be wired directly to the transmission for PTO control if J1939 is not possible or desired. Hardwired I/O control is identical to J1939 control whereas the PTO switch signal is sent to the transmission, the transmission provides the engagement consent to engage the PTO, and a confirmation is provided to the transmission indicating the engagement status.

Hardwired I/O Control Logic:

- Enable Switch Request - Input to Transmission to request PTO operation.
- Engagement Consent - Output from Transmission to enable PTO engagement.
- Engaged Confirm Status - Input to Transmission to confirm PTO is engaged.

The transmission can be configured to operate up to two PTO's wired directly to the transmission using the hardwired I/O pins on the transmission body connector.

Endurant XD

- PT01 Input / Output Calibration Package 4 in TRIG2630
- PT01 and PT02 Input / Output Calibration Package 5 in TRIG2630

Endurant XD Pro

- PT01 Input / Output Calibration Package 4 in TRIG2630
- PT01 and PT02 Input / Output Calibration Package 5 in TRIG2630
- SSPTO Input / Output Calibration Package 20 in TRIG2630
- SSPTO and PT01 Input / Output Calibration Package 21 in TRIG2630

Refer to the TRIG-2630 Endurant Series I/O Calibration Installation Guide for more information on the I/O packages listed above, as well as additional I/O packages for other optional features that can be hardwired to the transmission in conjunction with a PTO device.

Troubleshooting Hardwired PTO Control Issues

When the transmission is hardwired for PTO control and an I/O calibration is installed, the transmission will enable fault detection on the I/O pins used to assist in troubleshooting. It is important to wire all PTOs and other feature inputs as directed in the schematics provided in TRIG-2630 Endurant Series I/O Calibration Installation Guide.

Observations of a mis-wired PTO:

- Symptom - Grinding when the PTO switch is closed.
 - Root Cause - PTO engage relay/air solenoid not being controlled by the transmission's Engage consent output.
- Symptom - Clutch bumping/PTO disengaging within 5 seconds of when the PTO switch is enabled.
 - Root Cause - PTO Confirmation Input wire not connected or PTO ball switch faulty.

Always start with checking the transmission for any active fault codes related to the PTO wiring and correct any wiring errors. For example, if the transmission is programmed for PTO1 hardwired and has an active fault 3456 PTO Engage FMI 5, this indicates the transmission has detected an open circuit in the PTO consent engagement relay circuit (pin 2). This fault will prevent PTO operation.

If the transmission does not receive the Enable Switch Request, it will not provide the Engagement Consent output to engage the PTO. In the case of a SSPTO, the transmission needs to receive both the SSPTO Request and the SSPTO Confirmation inputs before the SSPTO function is allowed.

PTO grinding is typically a result of the PTO engagement not being controlled by the transmission. When wired properly, the transmission will open the clutch and stop the input shaft before engaging the PTO. If the PTO engagement is controlled directly from the PTO switch, this will result in grinding due to the clutch being closed and the input shaft/countershafts turning.

Refer to the Endurant XD Series Troubleshooting Guide TRTS-0960 for help with fault codes and troubleshooting hardwired PTO issues.

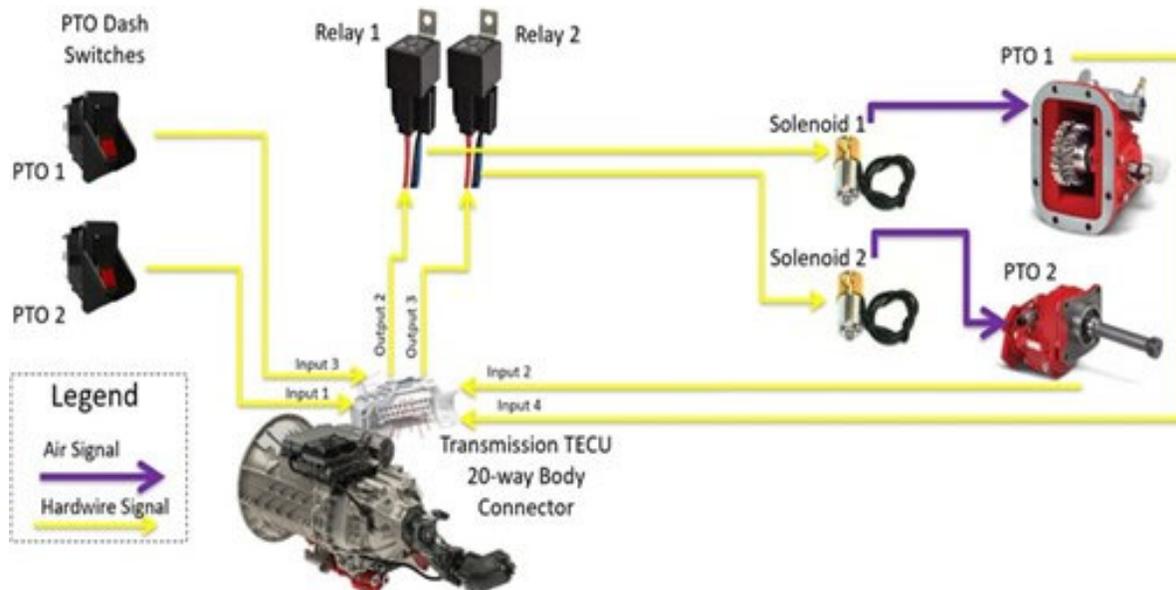


Figure 7 - PTO1 + PTO2 Hardwired Example

Troubleshooting Hardwired Split-Shaft PTO Control Issues

When the transmission is hardwired for SSPTO control and an I/O calibration is installed, the transmission will enable fault detection on the I/O pins used to assist in troubleshooting. It is important to wire all PTOs and other feature inputs as directed in the schematics provided in TRIG-2630 Endurant Series I/O Calibration Installation Guide.

Observations of a mis-wired Split-Shaft PTO:

- Symptom
 - Transmission not entering Split-Shaft PTO mode when selecting Drive
- Root Cause
 - Transmission not seeing SSPTO Request Input
 - Transmission not seeing SSPTO Confirmation Input
 - Transmission has an active fault code for SSPTO Engage consent output

Always start with checking the transmission for any active fault codes related to the SSPTO wiring and correct any wiring errors. For example, if the transmission has an active fault 3458 SSPTO Engagement Consent FMI 5, this indicates the transmission has detected an open circuit in the SSPTO consent output relay circuit (pin 3). This fault will prevent SSPTO operation.

If the transmission does not receive the Enable Switch Request, it will not provide the Engagement Consent output. In the case of a Split-Shaft PTO, the transmission needs to receive both the SSPTO Request and the SSPTO Confirmation inputs as well as no faults detected in the Engagement Consent output circuit before it will enter SSPTO mode.

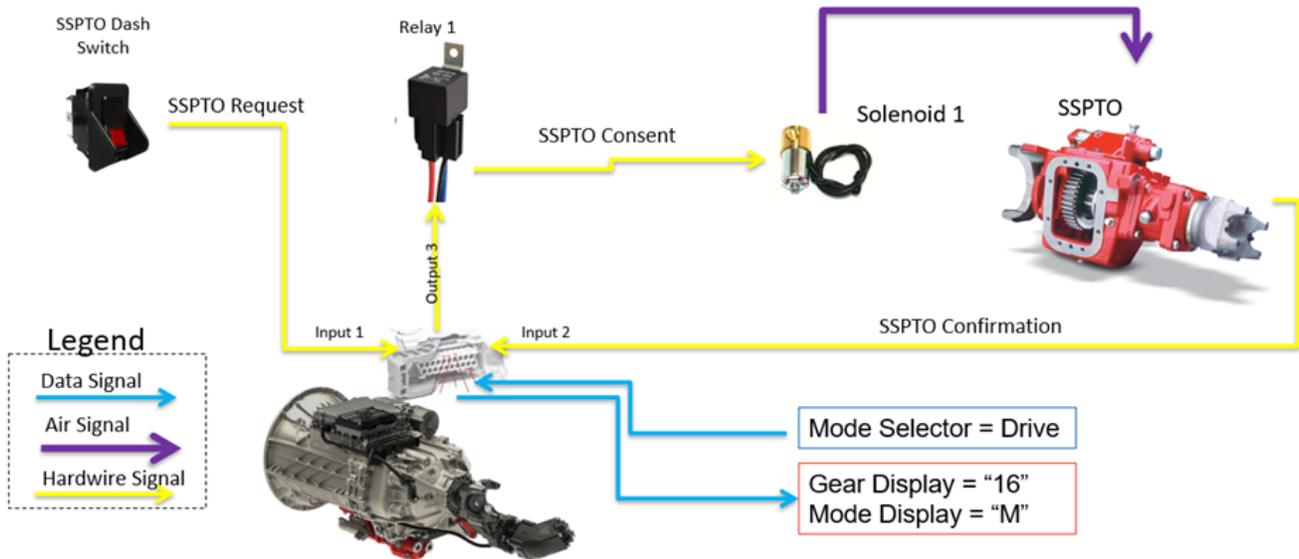


Figure 8 - SSPTO Hardwired Example

Using ServiceRanger to monitor the Hardwired I/O pins

ServiceRanger can be used to monitor the input voltages of the hardwired I/O pins on the 20-way body connector. This can be useful when troubleshooting an issue with the automated PTO control system to determine if the transmission is seeing the switched inputs.

1. Connect ServiceRanger to the vehicle and then Go To Data Monitor.
2. Select the Transmission PTO from the default parameter file list.

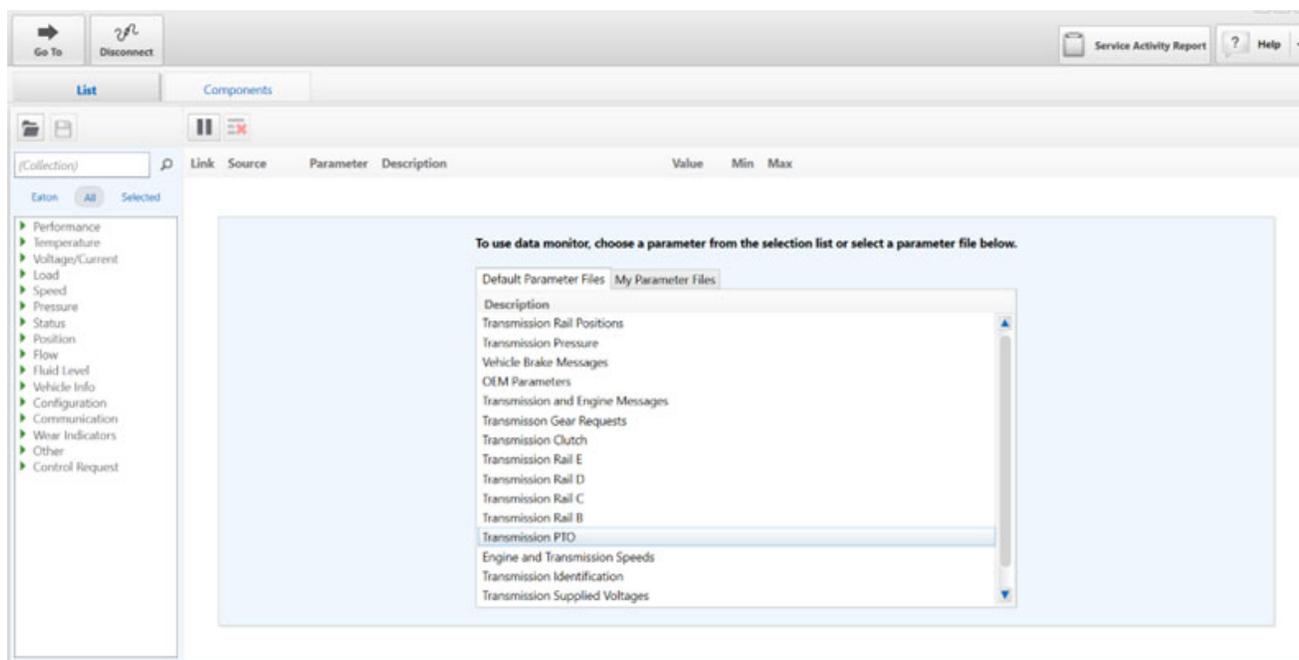


Figure 9 - ServiceRanger Screenshot

Here is a list of relevant parameters for a hardwired PTO:

PTO1

- Parameter 520537 - PTO Request voltage (Input #3)
- Parameter 520536 - PTO Confirmation voltage (Input #4)

PTO2

- Parameter 520581 - PTO2 Request voltage (Input #1)
- Parameter 520580 - PTO2 Confirmation voltage (Input #2)

Shaft Split-Shaft PTO (SSPTO)

- Parameter 520589 - SSPTO Request voltage (Input #1)
- Parameter 520588 - SSPTO Confirmation voltage (Input #2)

Voltages will be displayed as follows:

Input Off < 2.5 volts

Input On = 0.0 volts

Input Shaft PTO Operation - Endurant XD Series

The Endurant XD Series transmissions supports up to two transmission mounted PTOs which are driven directly from the input shaft of the transmission. Input shaft driven PTOs utilize the transmission's clutch to start and stop PTO operation once the PTO has been engaged. PTOs can be operated with the vehicle parked in neutral, or while moving the vehicle in a non-neutral mode.

PTO Operation while parked in Neutral

To engage a PTO:

1. Ensure the vehicle is at a complete stop.
2. Select Neutral (N) mode using the transmission driver interface device.
3. Set the vehicle parking brake and release the service brake.
4. Toggle the PTO switch to On to start PTO operation.

To disengage the PTO:

1. Toggle the PTO switch to Off.

Note: When the vehicle is stationary in neutral with the parking brakes set, the PTO can be switched on and off from within the cab or from a remote location outside of the cab.

PTO Operation while moving in Drive or Reverse

To engage a PTO:

1. Ensure the vehicle is at a complete stop.
2. Depress and hold the vehicle service brake.
3. Toggle the PTO switch to On.
4. Release the service brake to start driving, PTO operation will resume once the vehicle is in motion.

To disengage the PTO:

1. Toggle the PTO switch to Off.

Note: PTO can be disengaged while the vehicle is in motion.

Note: Refer to the Endurant XD Driver Instructions TRDR-0960 for information on transmission operation.

Split-Shaft PTO (SSPTO) Operation - Endurant XD Series

The Endurant XD Pro transmission supports Split-Shaft PTO operation which uses the vehicle's drive shaft to drive a PTO.

Note: Refer to the Endurant XD Driver Instructions TRDR-0960 for information on transmission operation.

To engage the SSPTO

1. Ensure the vehicle is at a complete stop.
2. Select Neutral (N) mode using the transmission driver interface device.
3. Set the vehicle parking brakes.
4. Depress the service brake pedal.
5. Switch the SSPTO switch to On.
6. Select Drive (D) mode using the transmission driver interface device.
7. Confirm the transmission has selected the correct gear for SSPTO operation (16th is default).
8. Release the service brake pedal to start SSPTO operation.
9. Increase engine speed to the appropriate SSPTO operating speed.

To change gears with SSPTO active

1. Return engine speed back down to idle.
2. Depress the service brake pedal to stop the SSPTO.
3. Use the driver interface device to select a higher (up) or lower (down) gear.
4. Release the service brake pedal to re-start SSPTO operation.
5. Increase engine speed to the appropriate SSPTO operating speed.

To dis-engage the SSPTO

1. Return engine speed back down to idle.
2. Depress the service brake pedal.
3. Select Neutral (N) mode using the transmission driver interface device.
4. Switch the SSPTO switch to Off.

Note: When the SSPTO is enabled, any vehicle movement detected by the transmission when the clutch is closing will result in the transmission immediately opening the clutch and canceling SSPTO operation.

Note: The vehicle can be moved (towed/pushed) once the SSPTO is in operation with the clutch fully closed and engine speed is operating above idle speed (SSPTO operating speed).

Note: The default start gear and the available range of gears for SSPTO operation.

PTO and Split-Shaft PTO Configurable Options

The Endurant Series transmission provides configurable options that can be enabled/disabled using ServiceRanger. Some options are restricted to certain models. Below is a brief description of each of these options.

Remote Ignition, Engine Start/Stop with PTO Active

The Remote Ignition and Engine Start/Stop with PTO Active is an optional J1939 Control setting for PTO1 and PTO2. This setting is intended for applications where the engine may need to be shut down and restarted remotely from outside of the cab while the PTO switch in the cab remains on. When this feature is enabled, the transmission will automatically re-engage the PTO once the engine is restarted.

This is an optional feature setting in ServiceRanger for PTO1 and PTO2 when using the J1939 datalink for PTO control.

To enable this feature, simply change the PTO configuration setting using ServiceRanger from J1939 Control Only to:

- J1939 Control Only - Remote Ignition or Engine Start/Stop Switch

Note: If the PTO is hardwired to the transmission and the transmission has an I/O calibration installed for PTO control, **DO NOT** change this parameter. Refer to TRIG-2630 Endurant Series I/O Calibration Installation Guide for calibrations that include the Remote Ignition, Engine Start/Stop with PTO Active feature **or** contact your Roadranger representative for more information about this setting.

Stop and Go Mobile PTO

The Stop and Go Mobile PTO option provides PTO power when the vehicle is stopped in Drive or Reverse. This option is useful when using the PTO in a mobile application and you need PTO power when bringing the vehicle to a stop. This eliminates the need to select Neutral to restore PTO power when stopped.

PTO Engaged Shifting (Endurant XD Series Only)

By default, all Endurant Series transmissions will not allow the transmission to be shifted out of the start gear when the PTO is engaged. The PTO Engaged Shifting option allows the operator to manually upshift/downshift the transmission when the PTO is engaged. PTO Engaged Shifting is only available for the Endurant XD Series transmissions and is limited to forward gears 1st - 9th and reverse gears R1 - R3.

Maximum Forward and Reverse Gears

The Endurant Series transmission can be configured to set a maximum forward and/or reverse gear whenever the PTO is engaged. This allows the vehicle to be restricted from operating the vehicle at higher speed when the PTO is engaged. Once the operator turns off the PTO, the transmission will resume normal operation.

Maximum Engine Speed and Vehicle Speed

The Endurant Series transmissions do not offer options to limit engine speed or vehicle speed when the PTO is engaged. This is done within the engine configurations. Consult the OEM on how to configure to limit engine speed and/or vehicle speed whenever the PTO is engaged.

Split-Shaft PTO Configurable Options (Endurant XD Pro Only)

The following options can be configured for the Split-Shaft PTO to tailor to its operation based on a particular application.

Options for Split-Shaft PTO (SSPTO) include the following:

- Default Forward Start Gear - Defaults to 16th
- Minimum Forward Gear - Defaults to 16th
- Maximum Forward Gear - Defaults to 16th
- Default Reverse Start Gear - Defaults to (not configured)
- Minimum Reverse Gear - Defaults to (not configured)
- Maximum Reverse Gear - Defaults to (not configured)

Note: The Default Forward or Default Reverse Gear must be in the range of the Minimum and Maximum Gears.

Additional Vocational Features/Options - Endurant XD Series

The Endurant XD Series Transmissions offer many features and options that can be configured to support a particular application or vocation. Some features can be configured to use either J1939 control messages or hardwired directly to the TECU by installing an I/O Calibration using ServiceRanger. This section gives an overview of some of these features in their intended application.

Rock Free

Rock Free Mode is a feature that is exclusive to the Endurant XD Pro transmission, as well as the Endurant HD-V and PACCAR TX-12 Pro model transmissions.

Rock Free Mode is intended to be used as a tool that can assist in getting a vehicle free from being stuck in sand, mud or snow. When the feature is enabled, the throttle pedal can be used to quickly open and close the clutch, creating a rocking motion, in both forward and reverse. Refer to TRDR-0960 Endurant Series Drivers Instruction Manual for more information on how to use Rock Free Mode.

Rock Free is typically installed at the factory and uses a factory installed dash switch to enable the feature. If the vehicle was not built with this feature, most OEM's offer this as a dealer install option. Contact your OEM Dealer on the availability of the Rock Free feature.

If the Rock Free feature was not installed by the OEM and a factory OEM switch is not available or desired, an aftermarket switch can be installed and hardwired directly to the transmission. Refer to TRIG-2630 Endurant Series I/O Calibration Installation Guide for calibrations and schematics that include the Rock Free feature.

Secondary Mode

Secondary Mode allows the transmission to be configured with two defined profiles (Primary/Secondary) that can be setup to provide optimal performance when the vehicle is operated in different environments (i.e. On-Highway/Off Road). These profiles can be toggled while the vehicle is in motion and can be configured to automatically revert back to the Primary Mode after a set time or after a set vehicle speed is reached.

Secondary Mode is typically set up at the factory and uses a factory-installed dash switch or is integrated into the OEM shift stalk. If the vehicle was not set up with this feature, most OEM's offer it as a dealer install option. Contact your OEM Dealer on the availability of the Secondary Mode feature.

If the Secondary Mode feature was not installed by the OEM and the factory option is not desired, an aftermarket switch can be installed and hardwired directly to the transmission. Refer to TRIG-2630 Endurant Series I/O Calibration Installation Guide for calibrations and schematics that include the Secondary Mode feature.

Paving Assist

Paving Assist is a feature that is intended for the vehicles used in a paving operation, most notable when the vehicle is being pushed by a paving machine while the transmission is in neutral. When the Paving Assist feature is enabled, the transmission can be shifted into Drive Mode without depressing the service brake and stopping the vehicle.

Paving Assist is a configuration option on the transmission that is enabled using ServiceRanger. When the feature is enabled, it automatically becomes active whenever the transmission is in neutral, the brake pedal is released and the vehicle is in motion.

Railroad Mode (Endurant XD Pro Only)

The Railroad Mode feature is exclusive to the Endurant XD Pro model transmission and is intended for vehicle used in high rail applications. When the vehicle rail gear is lowered onto the railroad tracks, an input is provided to the transmission to activate the transmission's Railroad Mode.

Railroad Mode can be activated by either using J1939 Control or a Hardwired I/O input.

Note: Hill Start Aid is disabled when Railroad Mode is active.

J1939 Control (refer to the SAE J1939 Digital Annex for more information)

EBC1 - Railroad Mode Switch

- ABS Controller - Source Address 0Bh/11
- Vehicle Management Computer - Source Address 27h/39
- Cab Controller Primary - Source Address 31h/49

Hardwired Control

- Refer to TRIG-2630 Endurant Series I/O Calibration Installation Guide for calibrations and schematics that include the Railroad Mode feature.

Electronic (ABS) Brake Controller in Railroad Mode

When the rail gear is lowered, the electronic ABS brake controller may activate its traction control when the vehicle is in motion and the front axle is off the ground. It is recommended to have a means to disable the traction control be either switching the traction control off or to place the electronic ABS brake controller in Railroad Mode. Consult your brake OEM or more information on how to appropriately disable traction control or to enable Railroad Mode on the electronic ABS brake controller (if available).

Note: Do not disable the electronic ABS brake controller by removing power from the module when the rail gear is lowered. The Endurant XD transmission is integrated with the electronic ABS brake controller and will set a fault and become inoperative if the transmission loses communication with the ABS controller over the J1939 datalink.

Forced/Hold Neutral

Forced and Hold Neutral are two features which are intended to be used to provide an override when neutral mode is desired by an operation other than the driver interface device.

Forced Neutral will place the transmission into Neutral Mode, regardless of what mode the operator has selected on the driver interface device.

Hold Neutral will hold the transmission in neutral when Neutral Mode is currently selected and prevent the transmission from going into gear if a non-neutral mode is selected on the driver interface device.

Forced/Hold Neutral can be activated by either using J1939 Control or Hardwired I/O input.

J1939 Control (refer to the SAE J1939 Digital Annex for more information)

TC1 - Transmission Auto-Neutral Request

- Body Controller - Source Address 21h/33
- Vehicle Management Computer - Source Address 27h/39
- Cab Controller Primary - Source Address 31h/49

Hardwired Control

- Refer to TRIG-2630 Endurant Series I/O Calibration Installation Guide for calibrations and schematics that include the Forced Neutral or the Hold Neutral feature.

Engine Mounted PTO's

The Endurant XD Series transmissions support the use of engine mounted PTO's (Front Engine or Rear Engine) in applications that require a live PTO. There are no additional configurations required in the transmission when using an engine-mounted PTO.

The transmission will automatically learn the parasitic load of the PTO whenever the following are true:

- PTO is active
- The transmission is in Drive or Reverse
- The vehicle is stopped with the brake pedal depressed

Snowplow Applications

The Endurant XD Pro transmission is approved for snowplow applications. If the application also requires the use of a live PTO, provisions need to be made to include an engine mounted PTO (FEPTO or REPTO) to provide PTO operation at highway speeds.

The Endurant XD Series transmissions do not have provisions for mounting an additional output shaft speed sensor, commonly used for spreader applications. Below are recommended J1939 datalink messages that can be used in the absence of a dedicated speed sensor.

- ETC1 - Transmission Output Shaft Speed
- EBC2 - Front Axle Speed
- CCVS - Wheel-Based Vehicle Speed

Note: Refer to the SAE J1939 Digital Annex for more information on these messages.

Note: Consult the chassis OEM for more information on how to properly interface with the J1939 datalink. **DO NOT** tap directly into the J1939 datalink or connect to the 9-pin diagnostic connector as this could result in derogation or failure of the datalink.

Enabling Features for J1939 Control

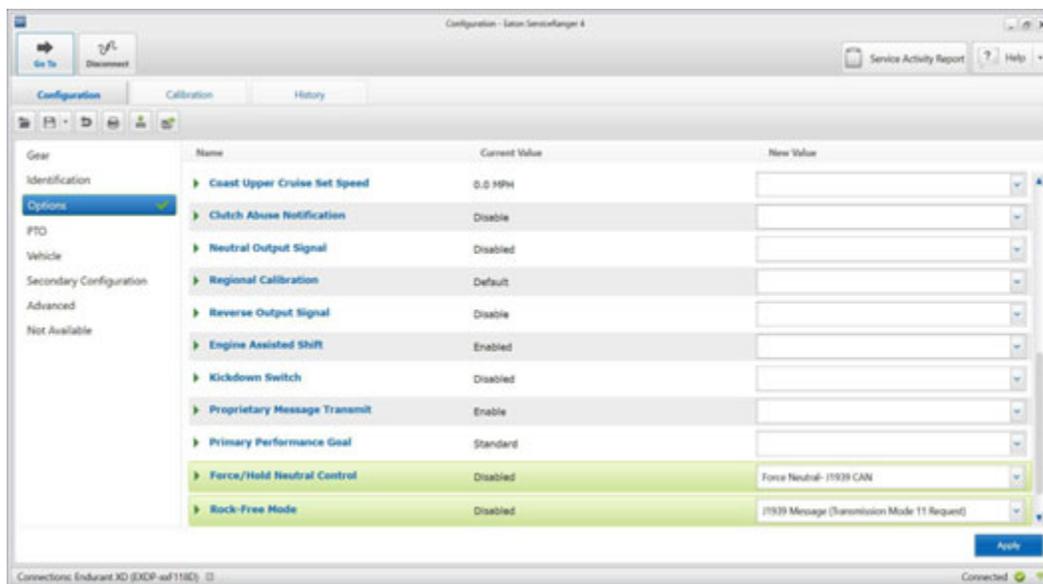
The following vocational features can be controlled by using J1939 messages over the J1939 datalink. Ensure the controlling device (VECU / Cab Controller / Body Controller) has been configured first before changing the transmission configuration.

When setting up the transmission feature for J1939 Control, complete the following steps:

- Connect to the vehicle with ServiceRanger using an approved communication adapter and then navigate to (Go To) the “Configuration” section.
- Use the table below to set the parameter value applicable to the device/feature you are installing.

Note: If the feature is hardwired directly to the transmission and not using the J1939 interface, do not change any of the parameters here. Skip to the “Configuring for Hardwired Control” section and install the relevant I/O calibration for the feature you have hardwired directly to the transmission.

ServiceRanger Configuration Group/Parameter	Configuration Parameter Value (J1939 CAN Control)
PTO / PTO1	J1939 Control J1939 Control - Remote Ignition or Engine Start/Stop Switch
PTO / PTO 2	J1939 Control J1939 Control - Remote Ignition or Engine Start/Stop Switch
PTO / Split-Shaft PTO	Stationary - All J1939 Inputs
Options / Rock-Free Mode	J1939 Message (Transmission Mode 11 Request)
Secondary Configuration / Secondary Mode Switch	J1939 Message
Options / Forced or Hold Neutral Control	Force Neutral - J1939 CAN Hold Neutral - J1939 CAN
Vehicle / Railroad Mode	J1939 Message



Enabling Features for Hardwired Control

Refer to TRIG-2630 Endurant Series I/O Calibration Installation Guide for a complete list of all the available calibration packages and associated wiring schematics.

Locate the appropriate I/O calibration package and wire the vehicle per the schematic associated with the feature package you are installing before installing the I/O calibration file into the transmission TECU.

 **WARNING:** Failure to follow instructions and wiring diagrams may result in major vehicle component damage, severe injury or death.

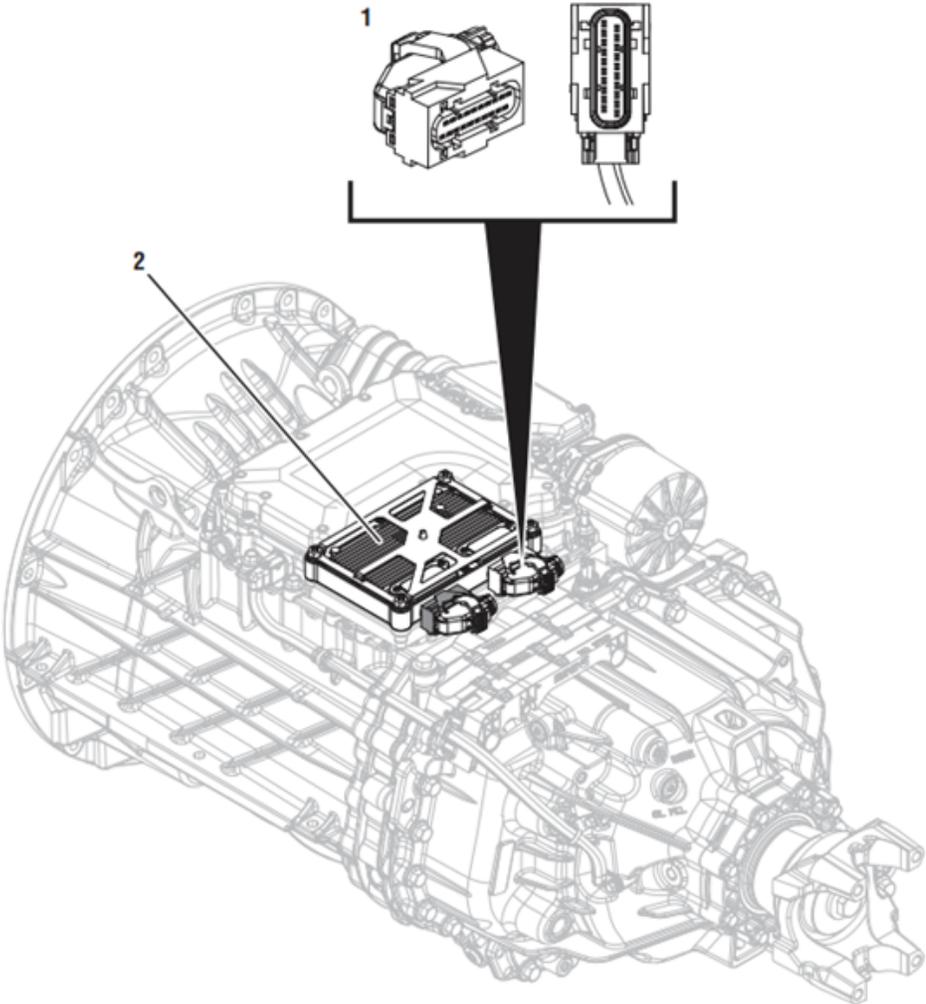
Installing the I/O Calibration file with ServiceRanger:

1. Key on with engine off.
2. Connect ServiceRanger with an approved communications adapter.
3. Go To “Configurations”.
4. Select “Calibration” tab.
5. Select “I/O” from the left-hand navigation pane.
6. From the “Other Available I/O Calibration Options” section, select the I/O Calibration Package being installed.
7. Select “Apply” and follow on-screen prompts.

Feature / Device	I/O Calibration Packages ⁽¹⁾ (Direct Hardwired Control)
Rock-Free Mode	Input / Output Calibration Package 2 in the TRIG-2630 -or- Input / Output Calibration Package 9 in the TRIG-2630
Secondary Mode Switch	Input / Output Calibration Package 2 in the TRIG-2630
Reverse Output Signal	Input / Output Calibration Package 10 in the TRIG-2630
Neutral Output Signal	Input / Output Calibration Package 36 in the TRIG-2630
Forced / Hold Neutral Control	Input / Output Calibration Package 14 and 15 in the TRIG-2630
Railroad Mode	Input / Output Calibration Package 47 in the TRIG-2630
PTO 1	Input / Output Calibration Package 4 in the TRIG-2630 -or- Input / Output Calibration Package 50 in the TRIG-2630
PTO 2	
Split-Shaft PTO (SSPTO)	Input / Output Calibration Package 20 in the TRIG-2630

(1) - When installing multiple devices/features (i.e. PTO 1 + Reverse Output), find the I/O calibration package that contains all the features you are installing. Only one calibration can be installed into the transmission at any one time.

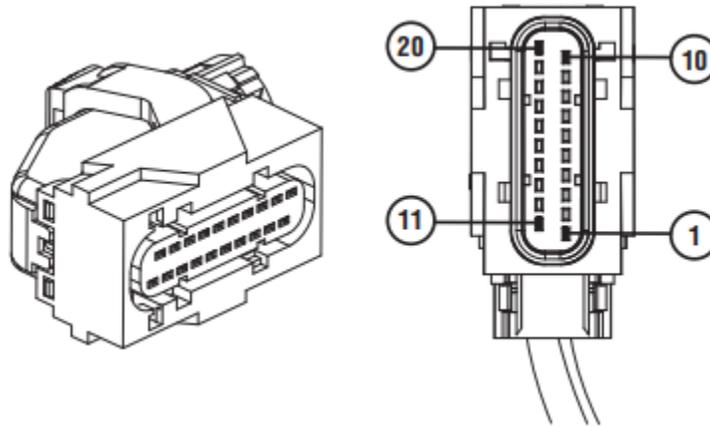
20-Way Body Connector



- 1. 20-Way TCM Body Harness Connector
- 2. Transmission Control Module (TCM)

20-Way Body Connector

20-Way Body Connector

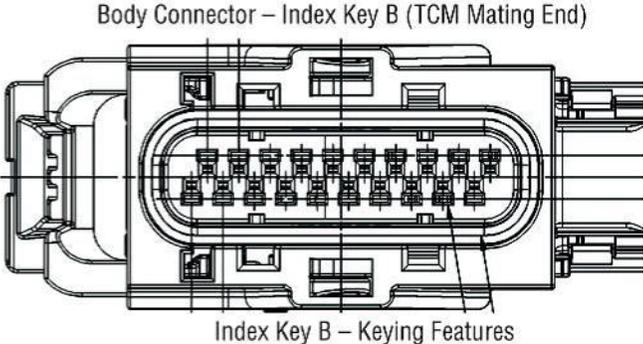


Body Connector Pin Number	Wire AWG	Circuit Description
B-1	18	Configurable Output 1
B-2	18	Configurable Output 2
B-3	18	Configurable Output 3
B-4	18	Configurable Input 2
B-5	18	Body I/O Return 1
B-6	18	Configurable Input 1
B-7	18	CAN B - High (Secondary J1939)
B-8	18	CAN B - Low (Secondary J1939)
B-9	18	Plugged (not used)
B-10	18	Plugged (not used)
B-11	18	Plugged (not used)
B-12	18	Plugged (not used)
B-13	18	Plugged (not used)
B-14	18	Body I/O Return 2
B-15	18	Configurable Input 3
B-16	18	Configurable Input 4
B-17	18	Forced / Hold Neutral Input 5
B-18	18	Plugged (not used)
B-19	18	Plugged (not used)
B-20	18	Plugged (not used)

20-Way Body Connector

The 20-way body connector is part of the OEM transmission harness and is installed on the transmission during manufacture.

- To add wires to the 20-way connector, first disconnect the connector from the transmission controller by releasing the cam lock.
- Remove the connector back shell and the secondary terminal lock.
- Remove terminal plugs in corresponding pin locations where new terminals/wires will be added.
- Only use approved terminals, seals, crimp tool, as well as the correct wire size (see below).



20-way TCM body connector terminals and seals required

Component	Aptiv (Delphi) Part #
Terminal	15471370
Wire Seal	15305351

Wire Size - 0.8 mm² (18 AWG) TXL Wire

20-Way Body Connector

Transmission Lubrication

Note: The transmission lubricant shall be approved per Eaton PS-386 requirements as documented in the Lubrication Manual TCMT0020.

A list of approved lubricants and suppliers can be found in the Approved Lubricant Supplier Manual TCMT0020. Not using the required lubricant will result in degraded performance and shortened life of the product.

- Lubrication capacity: 12 liters
- Additives and/or friction modifiers are not approved. Additives of any kind will result in unpredictable consequences. No liability of any kind will be accepted by Eaton for any damage resulting from the use of such additives.
- Failure to use the required lubricant will affect the transmission performance and the warranty coverage.
- All approved lubricants are required to display the PS-386 approved logo.



Lubrication Fill Procedure

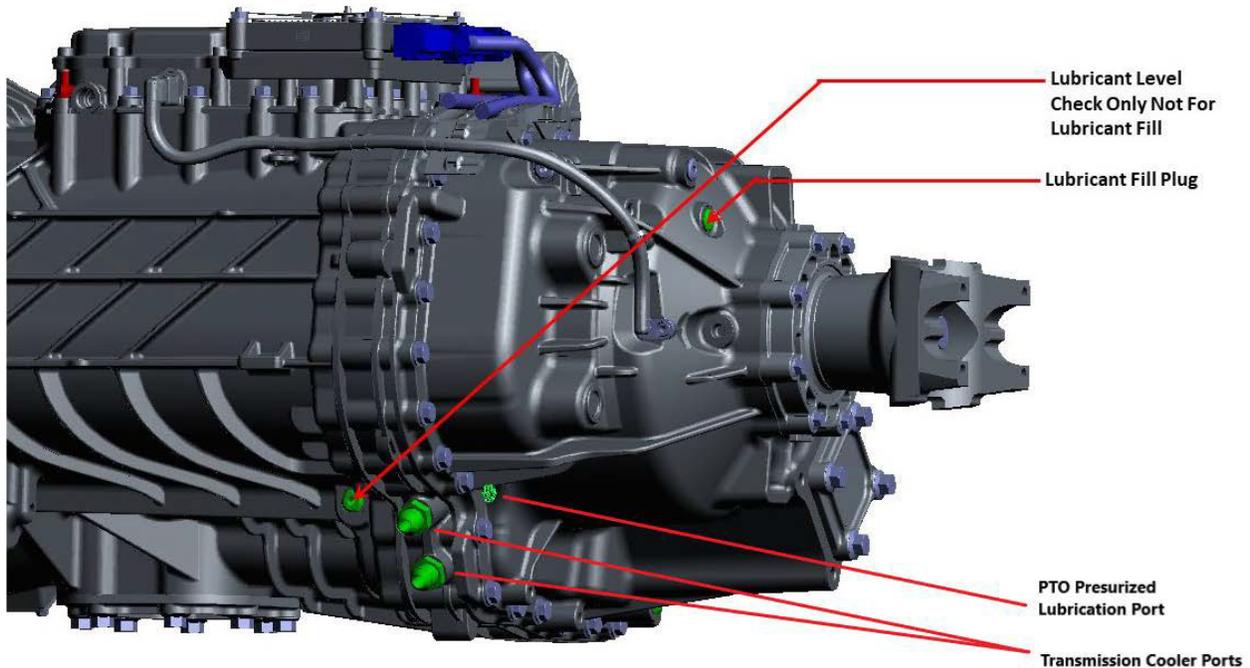
Endurant XD Series transmissions shall be filled with lubrication using a fill hole located at the top rear of the transmission rear case.

- Lubrication fill hole diameter: 16mm
- Lubrication fill plug drive: M18 x 1.5, 6mm Allen head inside hex
- Lubrication fill plug torque: 18 – 22 lb. ft. (24.5 – 29.5 Nm)

To install lubrication:

- Remove fill plug from top rear of transmission rear case.
- Follow established transmission lubrication fill process for selecting and dispensing lubrication. Ensure 12 liters of lubricant has been dispensed.
- Reinstall fill location plug and torque plug to 18 – 22 lb. ft. (24.5 – 29.5 Nm).
- Clean any lubrication residue from around the fill plug.

Note: The OEM plant may recognize a removable plug located on the lower left side of the transmission that is similar to the top rear fill hole plug. This plug is intended for verifying lubrication fill and is not recommended for use of filling the transmission due to proximity of internal gearing that restricts fill rate and introduces a high risk of transmission lubrication splashing back through the hole.



Verifying Lubrication Level in Vehicle

- Place vehicle on level ground and shut off engine.
- Remove lower left side oil level inspection plug from transmission case.
- Verify oil level is visible from this port. Allow excess oil to drain if overfull.
- Reinstall the oil level inspection plug and torque plug to 18 – 22 lb. ft. (24.5 – 29.5 Nm).
- Clean any lubrication residue from around the oil level inspection plug.

External PTO Lubrication Port

The Endurant XD Series transmission comes standard with an external PTO pressurized lubrication port on the rear of the transmission. This port is designed specifically to supply lubrication to a PTO only and should not be used for any other purpose.

Consult your PTO manufacture on information about adding a pressurized lubrication line as well as all the hoses and fitting required to connect it.

Transmission Cooling Requirements for PTO Operation

The Endurant XD series transmissions include provisions for an external transmission oil cooler. Use of a transmission cooler is dictated by the vehicle's intended application as well as the gross vehicle combined weight as specified by the vehicle OEM.

In the case of PTO operation, cooler requirements may be set by the body builder/upfitter and recommended based on the application. Stationary PTO operation, specifically Split-Shaft PTOs, have the potential for excessive heat buildup that could cause the transmission oil temperature to reach a point that could cause damage.

It is recommended that an external transmission oil cooler be used in sustained high horsepower stationary PTO operations as well as monitoring of the transmission oil temperature to prevent transmission overheating.

The Endurant XD Series transmissions broadcast the following J1939 message for transmission oil temperature (refer to the SAE J1939 Digital Annex for more information).

TRF1 - Transmission Oil Temperature 1

Refer to TRIG-0960 Endurant XD Series Installation Guide for information on Oil Cooler Provisions.

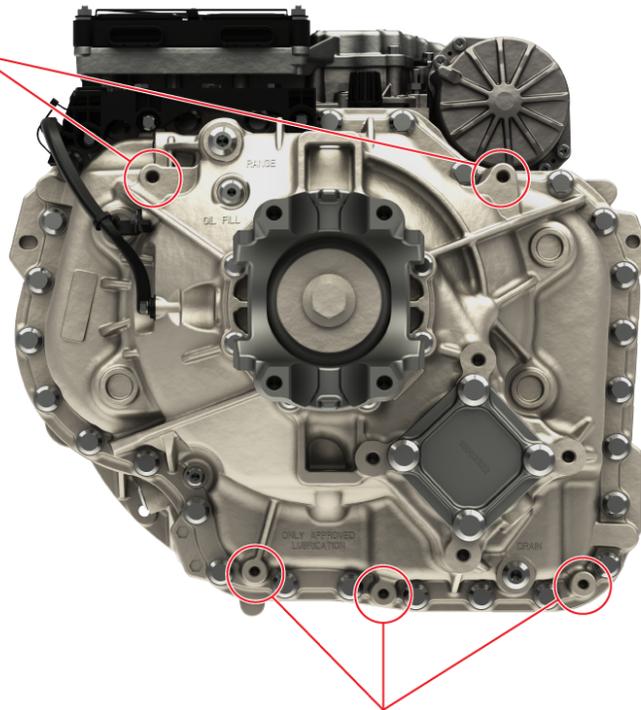
Endurant XD Series - PTO Support Brackets and Sealing

The Endurant XD Series transmission is equipped with threaded support bosses for PTO and pump support brackets at designated mounting locations. Consult PTO manufacturers for specific requirements. The following are included as a guideline for fabrication of support brackets and mounting.

Endurant XD Series PTO Support Brackets

REAR VIEW

**2 Top Rear of Rear Case
Rear Support Bosses
M12 X 1.75, 24mm Deep**



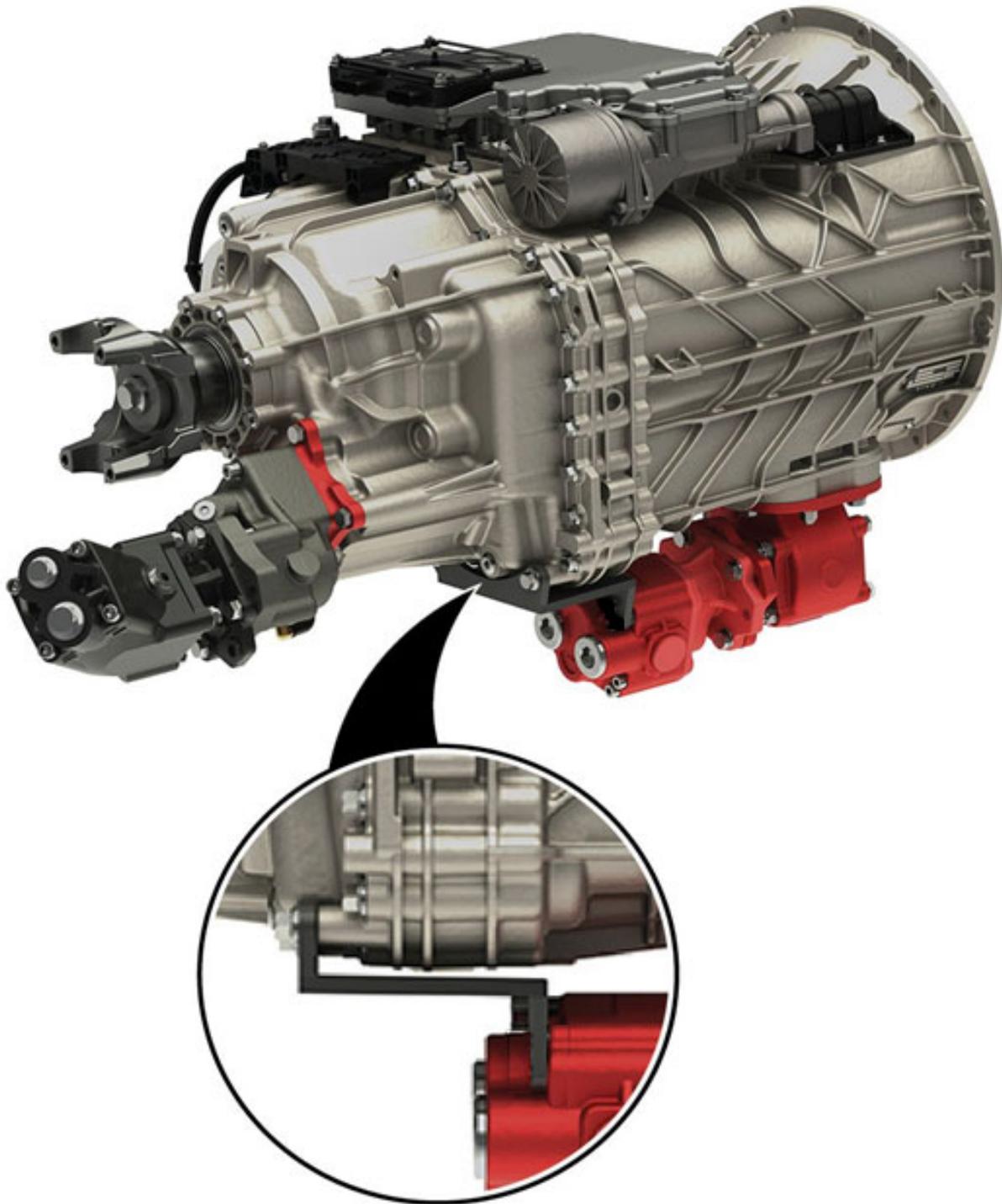
**3 Bottom Rear of Rear Case
Pre-Tapped Support Bosses
M10 X 1.5, 22.5mm Deep**

Use only Eaton approved support mounting locations. Not using the proper location could result in transmission damage.

Note: Lifting eyes may be removed after transmission is installed to the engine for installation of additional brackets/clips.

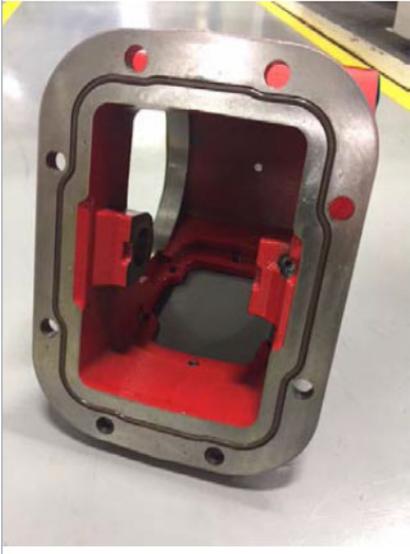
Follow PTO manufacturers guidelines for support requirements of their PTO.

Example PTO Support Bracket:



Note: The image above is intended to illustrate the PTO pump bracket mounting location on the transmission only. Consult your pump manufacturer on proper bracket attachment locations.

Endurant XD Series PTO Sealing Configuration Examples:



Chelsea: Push in place elastomer O-ring type seal	Muncie: Steel gasket with Edge molded elastomer seal	Bezars: Steel gasket with raised seal surface and elastomer coating on entire gasket surface
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All PTO manufacturers design the PTO spacing around their sealing method which eliminates the need for additional shims. It is important to use the seal that comes with the PTO. Consult your PTO manufacturer on questions about spacing and sealing.

PTO Manufacturers - Contact Information

Bezares USA

27634 Commerce Oaks Dr.

Oak Ridge North, TX 77385

(888) 663-1786

www.bezares.com

Chelsea Products Division

8225 Hacks Cross Road

Olive Branch, MS 38654

(662) 895-1011

www.parker.com/chelsea

Muncie Power Products, Inc.

P.O. Box 548

Muncie IN 47308-0548

(765) 284-0548

www.munciepower.com

SAE J1939 Digital Annex

Eaton Cummins transmissions adhere to all applicable J1939 standards as defined by the Society of Automotive Engineers (SAE). The SAE J1939 Digital Annex is a document published by the SAE which defines all the messages and parameters used on heavy truck and bus applications. The latest version of this document can be purchased by visiting the SAE website at www.sae.org/standards.

Change Control Log

Last Revised Date	Description of Clarifications and Updates
December 2024	Reformatting. Updated Warnings and Cautions page. Updated optional PTO wiring table.
September 2024	PTO section updates, removed I/O package schematics
December 2023	Nomenclature changes, Warnings and Cautions page overhaul
June 2023	Added PTO Configurations
August 2022	Endurant XD Series - PTO Inputs and Configurations section
May 2022	Published

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