Endurant XD Series PTO Installation and Body Integration Guide TRIG2620 EN-US

December 2023

EXD-xxF118D
EXDP-xxF118D

AUTOMATED TRANSMISSION™
TECHNOLOGIES

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SUPPORT

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Warnings and Cautions

This publication has been assembled to assist in the aftermarket upfit of the Endurant XD Series transmissions. For additional information such as transmission operation, troubleshooting or warranty information, please see the *Other Useful Publications* section in this manual.

The Endurant XD Series transmission system is designed to operate correctly and safely when the requirements in this installation guide are met, unintended or incorrect system operation could occur if requirements are not complied with. Contact your vehicle OEM for information on interfacing with non-transmission systems.

Failure to adhere to Eaton Cummins Automated Transmission Technologies installation requirements may affect transmission performance and/or warranty coverage. 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 within this manual. However, Eaton and Eaton Cummins Automated Transmission Technologies makes no warranty, either expressed or implied, based on the information provided. Eaton and Eaton Cummins Automated Transmission Technologies reserves the right to discontinue or modify models and/or procedures and to change specifications at any time without notice.

Important Notice

Any reference to brand name 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.

This symbol is used throughout this manual to call attention to procedures where carelessness or failure to follow specific instructions may result in personal injury and/or component damage.

Departure from the instructions, choice of tools, materials and recommended parts mentioned in this publication may jeopardize the personal safety of the service technician or vehicle operator.

Warning: Failure to follow indicated procedures creates a high risk of personal injury to the servicing technician.

Caution: Failure to follow indicated procedures may cause component damage or malfunction.

Important:
Highly recommended procedures for proper service of this unit.

Note:
Additional service information not covered in the service procedures.

Tip:
Helpful removal and installation procedures to aid in the service of this unit.

Always use genuine Eaton Cummins replacement parts.

PTO Configurations by Model - Endurant XD Series

PTO Availability

	Split Shaft PTO	Input Shaft PTO
Endurant XD	Not Available	Available (Default)
Endurant XD Pro	Available	Available (Default)

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						

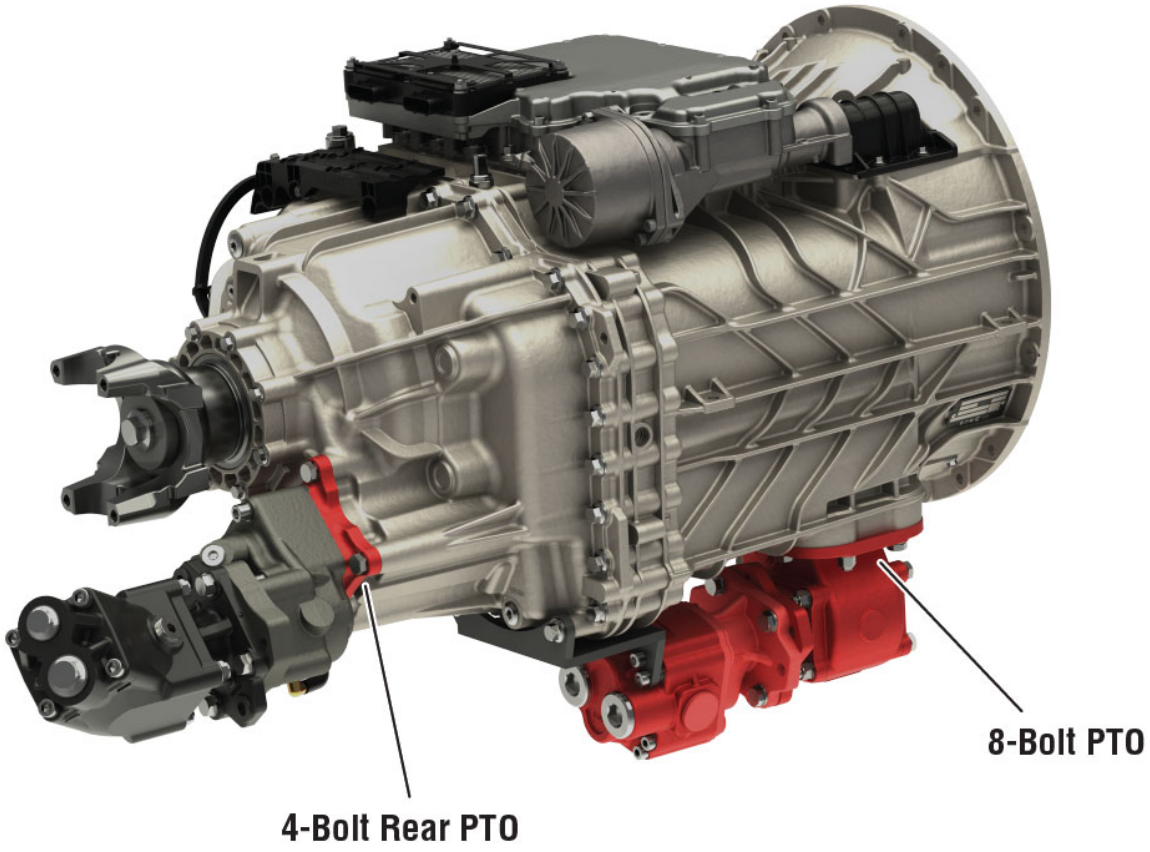
Note: (1) - Elastomer controlled squeeze seal required at PTO Transmission mounting surface. SAE 8-bolt PTO opening is standard on all Endurant XD Series transmissions.

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 8-bolt only, rear PTO only, or both PTO combined.

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

The Endurant XD Series transmission requires a new type of PTO, legacy PTO models are not compatible. Contact PTO manufacturer with the information in the chart above to verify the correct PTO for the Endurant Transmission. Failure to use the correct PTO results in transmission damage.



Transmission PTO System Engagement Sequence

The Endurant XD Series transmission is designed to provide an enhanced acknowledgment for PTO applications. The TCM will receive a “PTO request” from the vehicle to enter into a PTO mode. If the TCM deems that conditions are suitable for PTO operations, the TCM will supply a “PTO engage” output to allow the PTO engagement. A confirmation from the PTO returns to the TCM via the “PTO confirm” line to complete the loop.

1. The TCM receives a “PTO request” message or signal from the vehicle to enter into a PTO mode.
2. The TCM verifies conditions are met for PTO operation. If conditions are met, the TCM supplies a “PTO engage” output to allow PTO engagement.
3. The TCM receives a “PTO confirm” message or signal that the PTO is physically engaged and the system is ready for operation.

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

PTO Control Using J1939 - Endurant XD Series

The Endurant transmission uses the SAE J1939 Power Take Off Drive Engagement (PTODE) message for all PTO J1939 Control. This is the same control method used by the OEM when using a factory installed setup. This section is intended to guide a body builder when creating a control system that can interface with the transmission for PTO control over the J1939 datalink when using the OEM chassis controller is not desired or possible.

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 logic for PTO control requires that the PTO enable switch signal is sent to the transmission and the transmission will provide the engagement consent to allow 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. At this point the clutch will fully close.

There are three parameters used in the PTODE message for each PTO. The controlling device as well as the transmission shall both broadcast this message. The specific parameters are sent from each device as follows with a value of 0 (false) to 1 (true):

Transmission	Direction	Controlling Device
Enable Switch (receive)	⇦	Enable Switch (send)
Engagement Consent (send)	⇨	Engagement Consent (receive)
Engagement Status (receive)	⇦	Engagement Status (send)

PTODE Message Broadcast from the Transmission and the Controlling Device

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

Input-Shaft PTO 1:

- Enable Switch - Transmission input shaft PTO 1
- Engagement Consent - Transmission input shaft PTO 1
- Engagement Status - Transmission input shaft PTO 1

Input-Shaft PTO 2:

- Enable Switch - Transmission input shaft PTO 2
- Engagement Consent - Transmission input shaft PTO 2
- Engagement Status - Transmission input shaft PTO 2

Split-Shaft PTO (SSPTO):

- Enable Switch - Transmission output shaft PTO
- Engagement Consent - Transmission output shaft PTO
- Engagement Status - Transmission output shaft PTO

The Endurant transmission will accept PTODE control messages from the following controlling devices on the J1939 datalink:

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

Refer to the SAE J1939 Digital Annex for more information on the PTODE message.

The transmission can be configured to operate up to two PTO's using the PTODE control message for the Endurant XD, and up to three for the XD Pro model. Refer to the ServiceRanger Configuration section for information on configuring the transmission for PTO control over J1939.

Endurant XD:

- PTO1
- PTO1 and PTO2

Endurant XD Pro:

- PTO1
- PTO1 and PTO2
- SSPTO
- SSPTO and PTO1
- SSPTO, PTO1 and PTO2

Troubleshooting PTODE Control Issues over J1939

At key on, the Endurant transmission first checks its configuration. If it is configured for a J1939 controlled PTO, it will immediately search the datalink for a device sending a PTODE message containing valid data within the above-mentioned parameters. Valid data is defined as any value of 0 (false) or 1 (true). Any parameters received with a value of 2 (error) or 3 (not available) will result in the transmission setting a fault if that parameters is relevant to how the transmission is configured.

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 (0 or 1) for the PTO it is controlling. All other parameters not used by the controlling device shall be sent as 3 (not available).

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

- PTO1 I/O Package #4
- PTO1 and PTO2 I/O Package #5

Endurant XD Pro

- PTO1 I/O Package #4
- PTO1 and PTO2 I/O Package #5
- SSPTO I/O Package #20
- SSPTO and PTO1 I/O Package #21

Refer to the ServiceRanger Configuration and I/O Calibration Package Index and Schematics sections of this document 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 along with a PTO.

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 the I/O Calibration Package Schematics section in this document.

Symptoms of a mis-wired PTO that may not result in setting a fault code are grinding, clutch bumping, or the PTO failing to engage.

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, when the SSPTO switch is turned on and the transmission placed into Drive Mode, the transmission will enter Auto-Neutral due to the parking brakes being set and the transmission not receiving the Engagement Consent input from the SSPTO switch.

PTO grinding is typically a result of the PTO engagement not being controlled by the transmission. When wired properly, the PTO engagement will be controlled bu the Engagement Consent output from the transmission. 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 turning.

When the switch is turned on and you notice what feels like the clutch bumping and not staying closed, this is typically a symptom of the transmission not receiving an engagement confirmation signal from the PTO. It is important to properly wire the engagement switch located on the PTO to the engagement confirmation input on the transmission. The engagement switch on the PTO is a common failure point for this symptom.

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

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.

Vocational Applications and Features - Endurant XD Series

The Endurant XD Series Transmissions offer many features and options that can be configured to support a particular application or vocation. These features can be controlled using 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.

Remote Ignition, Engine Start/Stop with PTO Active

Remote ignition and engine start/stop with PTO active 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 re-started.

This is an optional feature of the PTO1 and PTO2 configurations in ServiceRanger. To enable this feature, simply change the PTO configuration from J1939 Control Only to J1939 Control Only - Remote Ignition or Engine Start/Stop Switch.

If the PTO is hardwired to the transmission with an I/O calibration installed, contact Eaton Cummins service engineering on available I/O calibration options for this feature.

Railroad Mode (Endurant XD Pro Only)

The Railroad Mode feature is exclusive to the Endurant XD Pro model transmission and is intended for vehicles 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. Refer to the ServiceRanger Configuration section on how to configure the transmission for Railroad Mode.

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 I/O (Refer to the I/O Calibration Section)

- High Rail (Railroad Mode) - I/O Package #47

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 by either switching the traction control off or to place the electronic ABS brake controller in Railroad Mode. Consult your brake OEM from more information on how to appropriately disable traction control or to enable Railroad Mode on the electronic ABS brake controller (if available).

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

The Forced and Hold Neutral are two features which are intended to be used to provide an override when neutral mode is desired by another operation other than the driver interface device. An example would be when outriggers are deployed and moving the vehicle would not be desired.

Forced Neutral will place the transmission into neutral 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 a Hardwired I/O input. Refer to the ServiceRanger Configuration section on how to configure the transmission for Forced/Hold Neutral.

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 I/O (See I/O Calibration Section)

- Forced Neutral - I/O Package #14
- Hold Neutral - I/O Package #15

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 no have provisions for mounting an additional output shaft speed sensor commonly used for spreader applications. Below are a few recommended J1939 datalink messages that can be used in lieu of using a dedicated speed sensor.

ETC1 - Transmission Output Shaft Speed

CCVS - Wheel-Based Vehicle Speed

EBC2 - Front Axle Speed

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

Note: Consult the chassis OEM for information on how to interface with the chassis J1939 datalink.

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 is 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

ServiceRanger Configurations

ServiceRanger is a PC based application used to program, configure, and troubleshoot the Endurant XD series transmission. This section is intended to guide you on how to configure the transmission to enable different features including PTO control.

Note: Visit www.roadranger.com for information on how to purchase ServiceRanger.

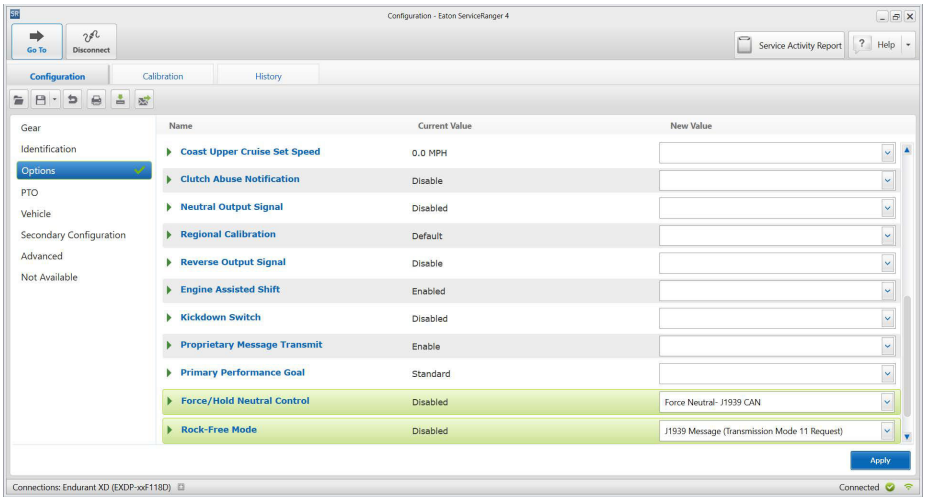
Configuring Vocational Features with ServiceRanger

The following vocational features can be controlled by either using a J1939 message or a hardwired input to the transmission. Connect to the vehicle with ServiceRanger using an approved communication adapter and then navigate to the "Configurations" section. Find the feature in the Configuration options to enable a feature using J1939 message control. If the feature is hardwired, navigate to the Calibration tab and install the appropriate I/O Calibration package for the feature you are installing. Enable the feature after the control for the feature has been installed.

Feature	Configuration Options (J1939 Implementation)	I/O Calibration[1] (Hardwired)
Rock-Free Mode	J1939 Message	I/O Package #9
Reverse Output Signal	N/A[2]	I/O Package #10
Neutral Output Signal	N/A[2]	I/O Package #36
Forced/Hold Neutral Control	Force Neutral - J1939 CAN Hold Neutral - J1939 CAN	I/O Package #14 I/O Package #15
PTO1	J1939 Control J1939 - Remote Ignition	I/O Package #4
PTO2	J1939 Control J1939 - Remote Ignition	I/O Package #5
Split-Shaft PTO	Stationary - All J1939 Inputs	I/O Package #20
Railroad Mode	J1939 Message	I/O Package #47

1 - See additional I/O Calibration Packages when combining features that are hardwired.

2 - J1939 messages for Reverse and Neutral states are broadcast by default and do not require additional configuration.



NOTICE: Do not change any configurations in the transmission that are not relevant to the equipment you are installing without the explicit consent of the OEM, Eaton Cummins Transmission, or the vehicle owner.

J1939 PTO Setup

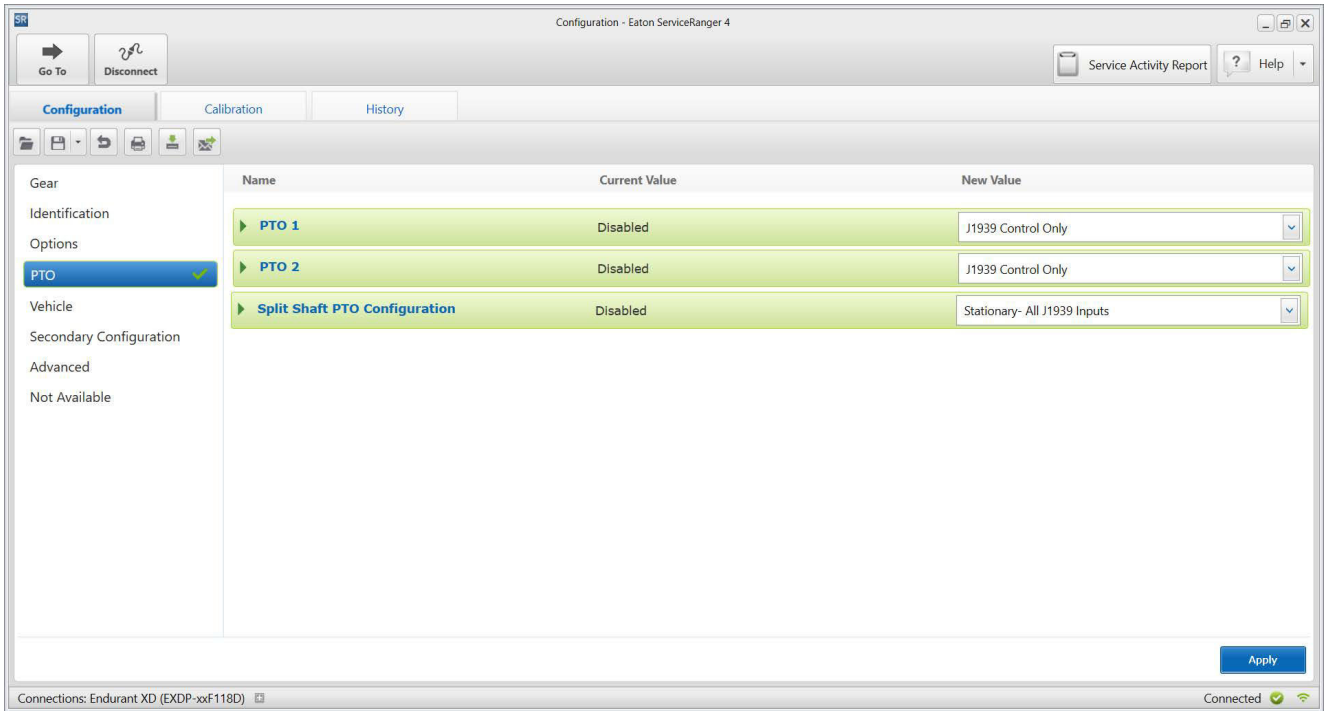
Connect to the vehicle with ServiceRanger using an approved communication adapter and then navigate to the “Configurations” section. Select the PTO section to find the options to enable one or two input shaft driven PTOs as well as a Split-Shaft PTO.

Options for PTO1 and PTO2 include the following:

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

Options for Split-Shaft PTO include the following:

- Stationary - All J1939 Inputs



Split-Shaft PTO Configurable Options

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

To change the SSPTO options, connect to the vehicle with ServiceRanger using an approved communication adapter and then navigate to the “Configurations” section. Select the PTO section to find the options for Split-Shaft PTO.

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)

The SSPTO defaults to operate in 16th gear only by default but can be configured to allow the operator to have the option to select a specified range of gears as well as operate in the reverse gears if the application warrants.

Note: 16th is Direct Drive in the 18D ratio set.

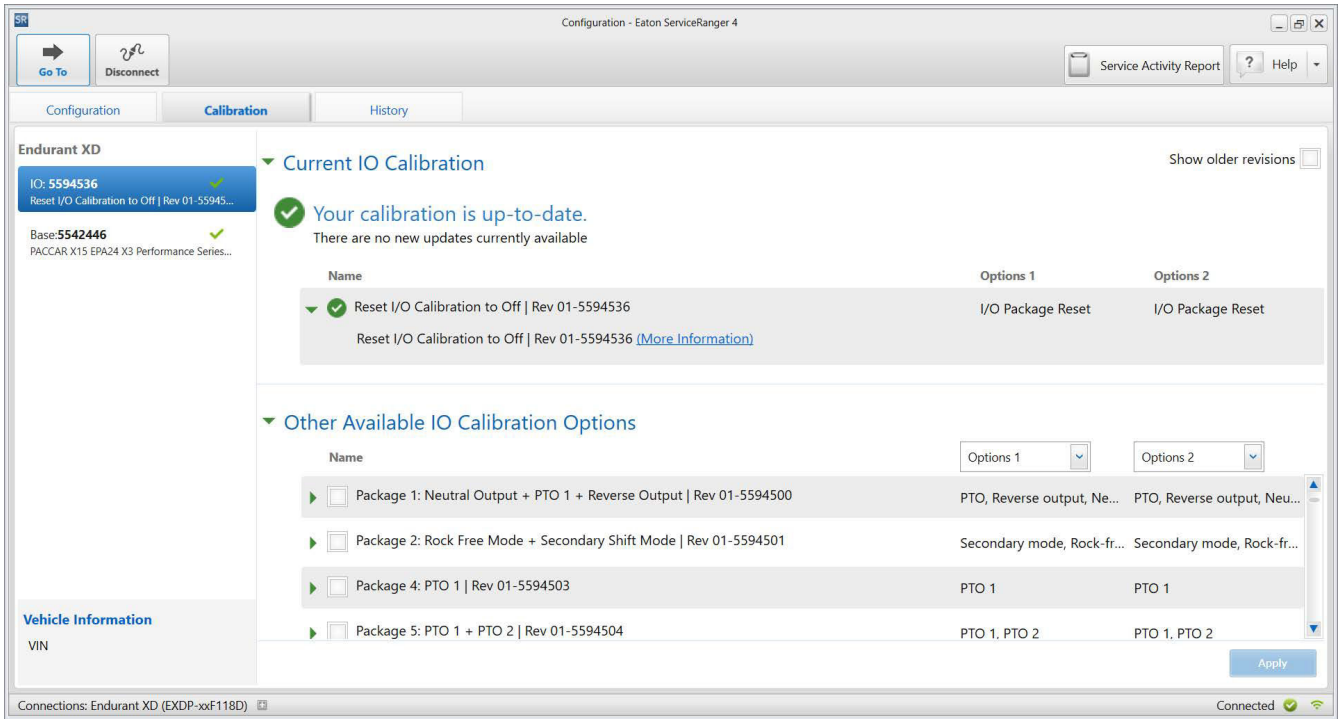
These configurations are independent on how the SSPTO is controlled, J1939 or Hardwired, and can be utilized for either setup.

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

Hardwired Input Shaft and Split-Shaft PTO Setup

If using J1939 control is not an option or desired, PTO control can be done by hardwiring directly to the transmission. To see a list of all the hardwired options for the Endurant XD Series transmission, refer to the I/O Calibration Package Index section in this document as well as the I/O Calibration Package Schematics section for information on how to wire the transmission based on the calibration installed.

Once the transmission has been properly wired per the schematics provided for your setup, connect to the vehicle with ServiceRanger using an approved communication adapter and then navigate to the “Configurations” section. Select the Calibration tab and then select the I/O Calibration on the left-hand pane. Scroll through the list of calibrations until you find the one that matches the package you have wired.



I/O Calibration Package Installation Process

1. Identify I/O Calibration Package based on the vocational feature(s) to be installed - Reference I/O Calibration Package Index below.
2. Install vocational feature components (PTO, Reverse Switch, etc.) and associated wiring - Reference I/O Calibration Package wiring diagram.

   WARNING: Follow all OEM and/or vocational feature manufacturer installation instructions and recommended wiring diagram. Failure to follow instructions and wiring diagrams may result in major vehicle component damage, severe injury or death.
3. Key on with engine off.
4. Connect ServiceRanger.
5. Go To “Service Reports”.
6. Select “Service Activity Report”.
7. Enter required information and select “Start Report”.
8. Select “Send to Eaton”.
9. Go To “Configuration”.
10. Select “Calibration” tab.
11. From the “Other Available IO Calibration Options” section, select I/O Calibration Package identified in Step 1.
12. Select “Apply” and follow on-screen prompts.
13. Verify vocational feature operation, per OEM and/or vocational feature manufacturer guidelines.
    - If feature operates as intended and no fault code is set Active, process complete.
    - If feature does not operate as intended and a fault code sets Active, troubleshoot per Endurant XD Automated Transmission Troubleshooting Guide TRTS0960, “Fault Code Isolation Procedure Index” on page 13.

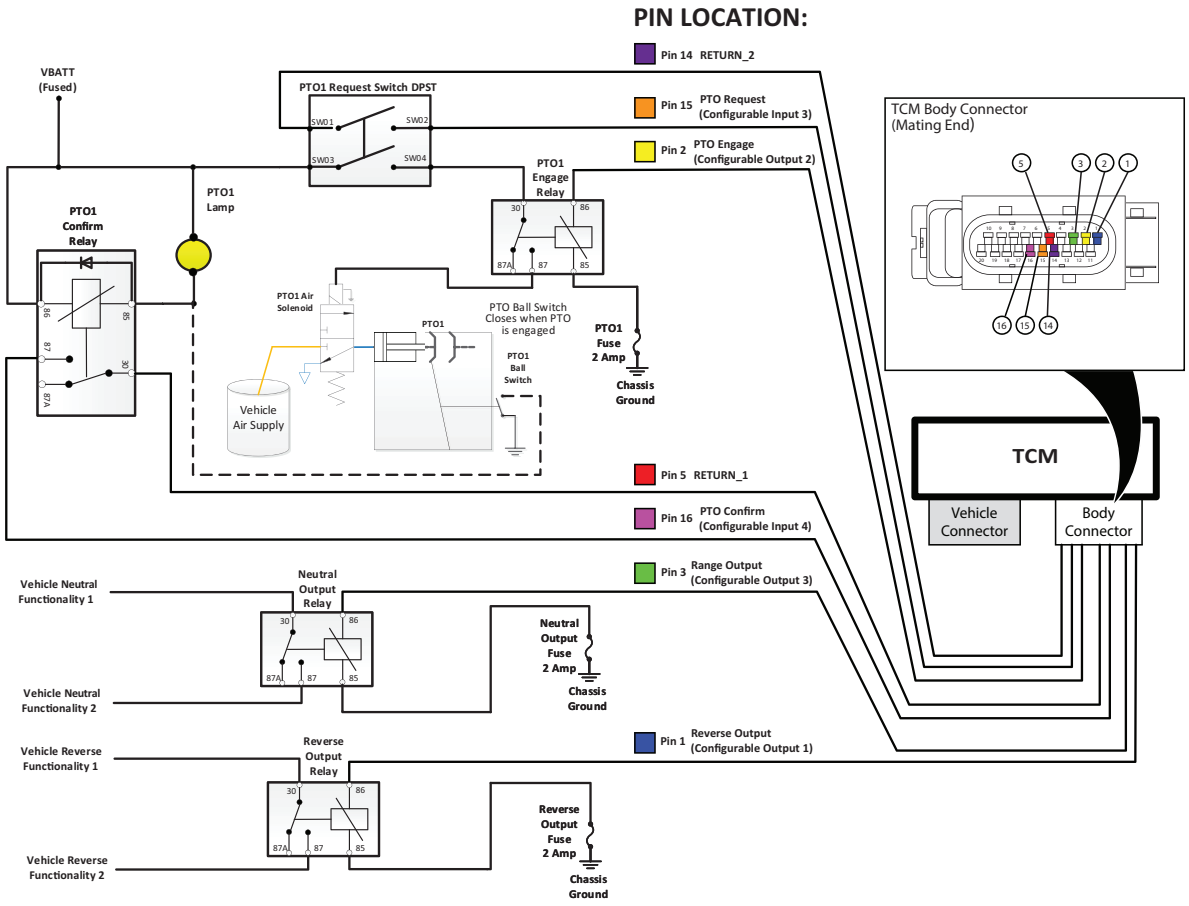
I/O Calibration Package Index

I/O Package	I/O Calibration Package Description
1	PTO 1 + Reverse Output + Neutral (Range) Output
2	Rock Free Mode + Secondary Shift Mode
3	Aux Trans + Rock Free Mode
4	PTO 1
5	PTO 1 + PTO 2
6	PTO 1 + Secondary Configuration Mode
7	PTO 1 + Rock Free Mode + Secondary Configuration Mode
8	PTO 1 + Reverse Output + Rock Free Mode
9	Rock Free Mode
10	Reverse Output
11	PTO 1 + Reverse Output
12	Aux Trans
13	Aux Trans + Secondary Shift Mode
14	Force Neutral
15	Hold Neutral
16	2-Speed Axle
17	2-Speed Axle + Rock Free Mode
18	PTO 1 + 2-Speed Axle
19	2-Speed Axle + Secondary Shift Mode
20	SSPTO
21	PTO 1 + SSPTO
22	PTO 1 + Force Neutral
23	PTO 1 + PTO 2 + Force Neutral
24	Force Neutral + Neutral Output + Reverse Output
25	PTO 1 + Hold Neutral
26	PTO 1 + PTO 2 + Hold Neutral
27	Hold Neutral + Neutral Output + Reverse Output
29	PTO 1 + Rock Free Mode
30	Reverse Output + Secondary Mode
31	Reverse Output + Rock Free Mode

I/O Package	I/O Calibration Package Description
32	2-Speed Aux Trans + Reverse Output
33	2-Speed Axle + Reverse Output
34	PTO 1 + PTO 2 + Reverse Output
35	Reverse Output + Neutral Output
36	Neutral Output
37	I/O Package Reset to Off Note: This package is used to reset or turn off an I/O Calibration Package configured in the TCM.

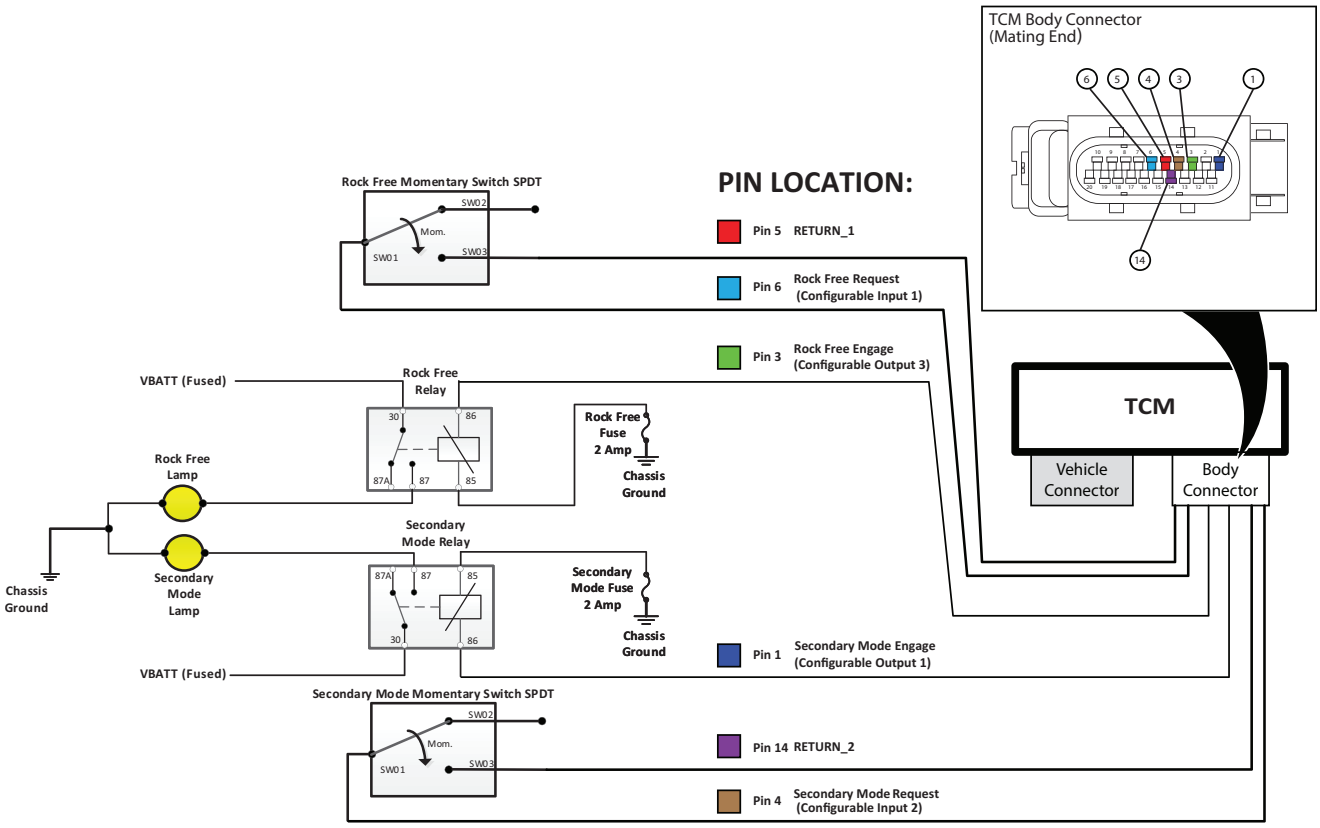
Input / Output Calibration Package 1

PTO 1 + Reverse Output + Neutral (Range) Output



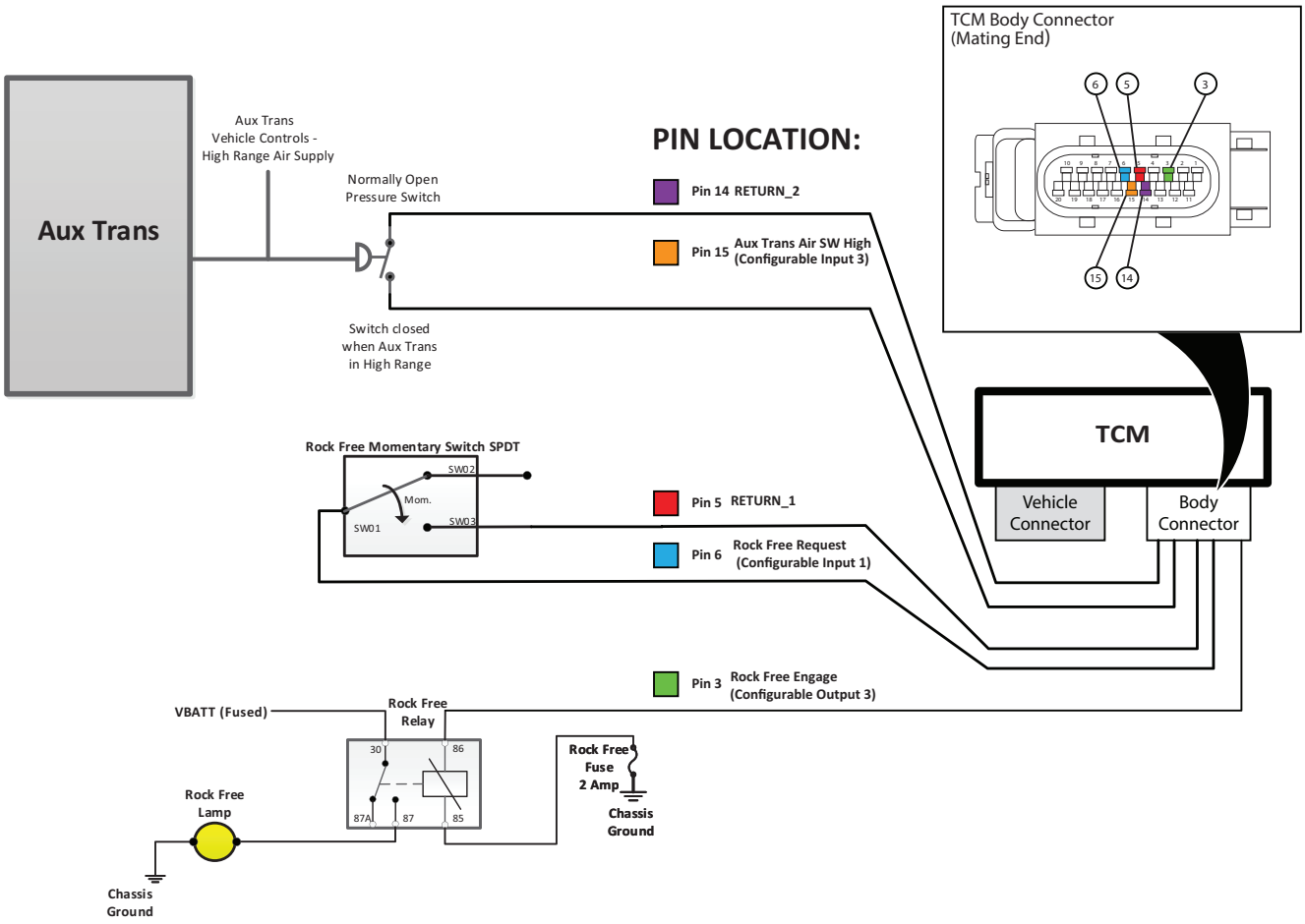
Input / Output Calibration Package 2

Rock Free Mode + Secondary Shift Mode



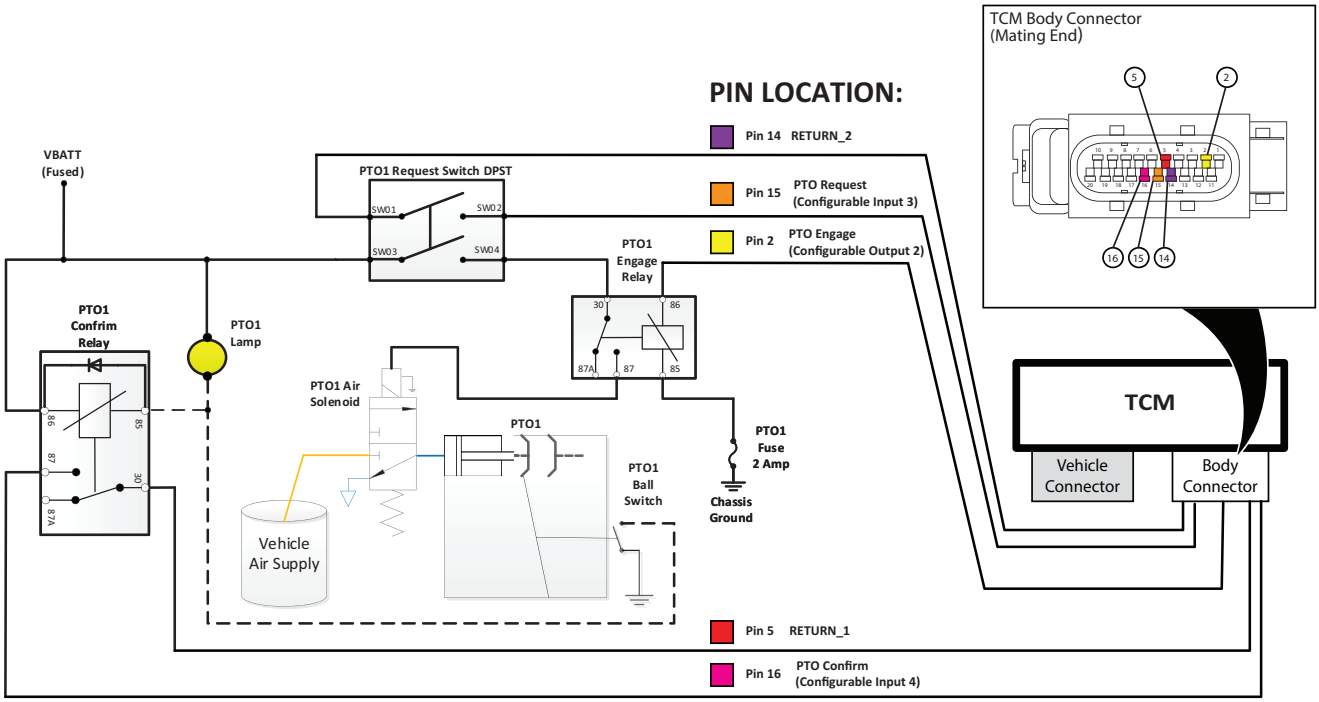
Input / Output Calibration Package 3

Aux Trans + Rock Free Mode



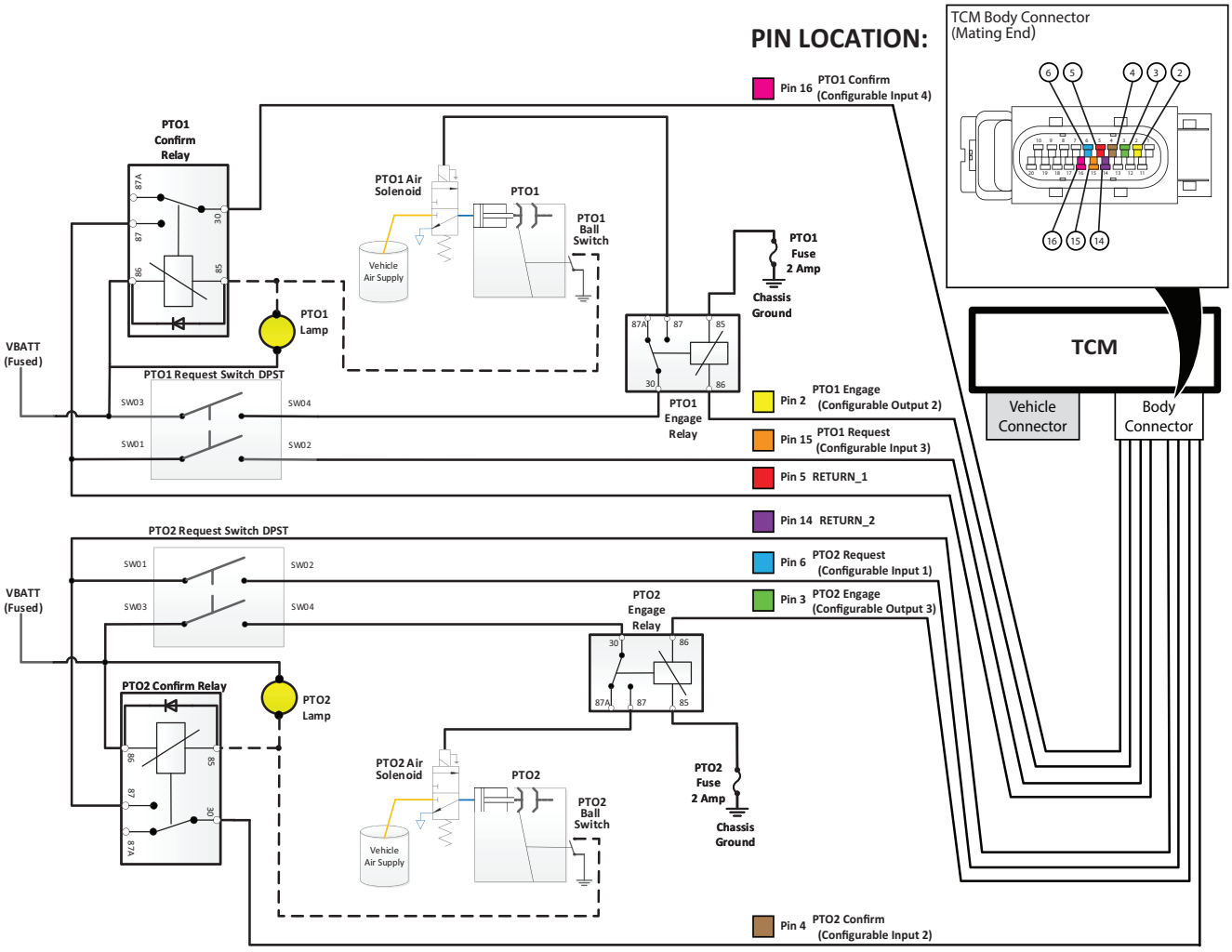
Input / Output Calibration Package 4

PTO 1



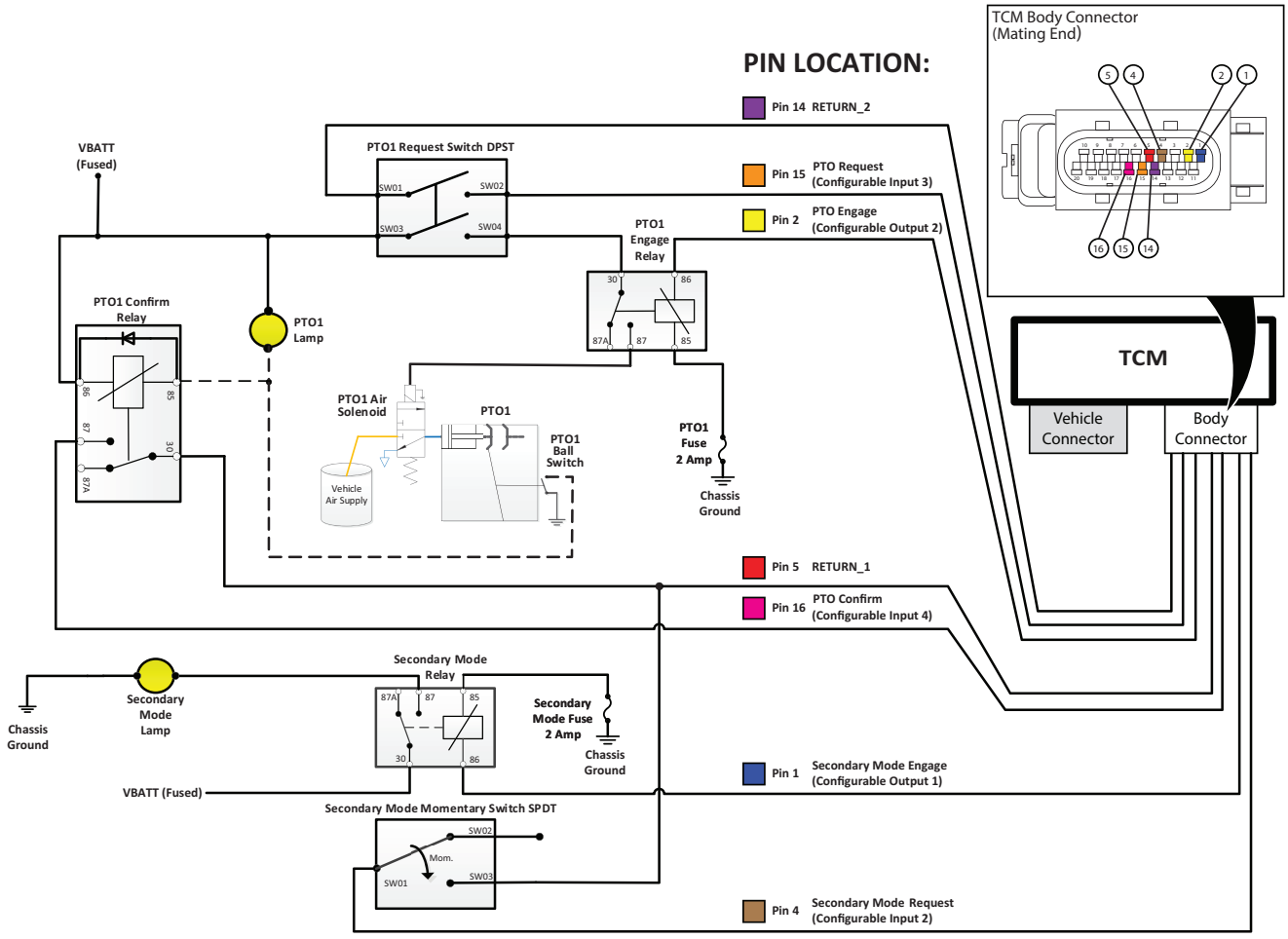
Input / Output Calibration Package 5

PTO 1 + PTO 2



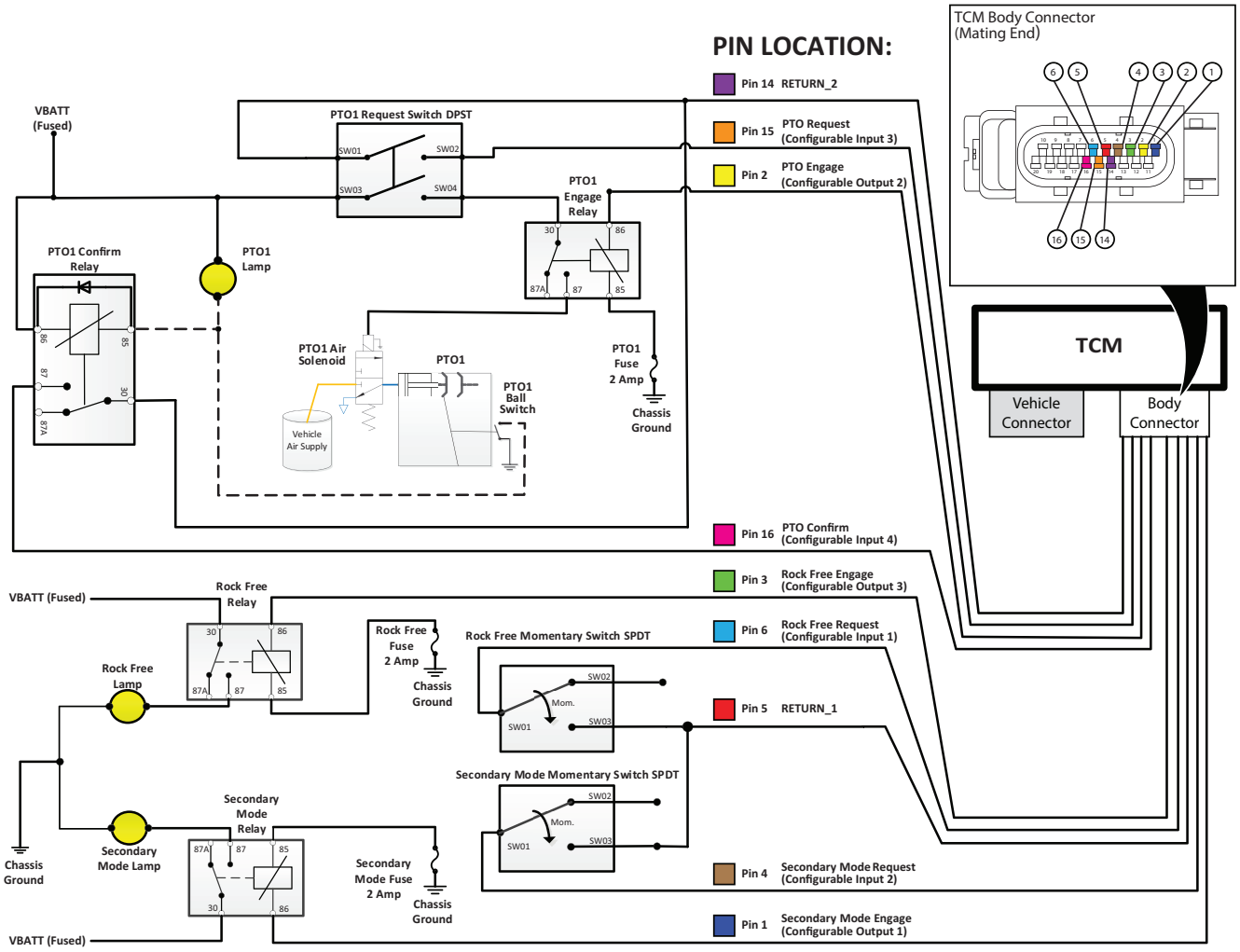
Input / Output Calibration Package 6

PTO 1 + Secondary Configuration Mode



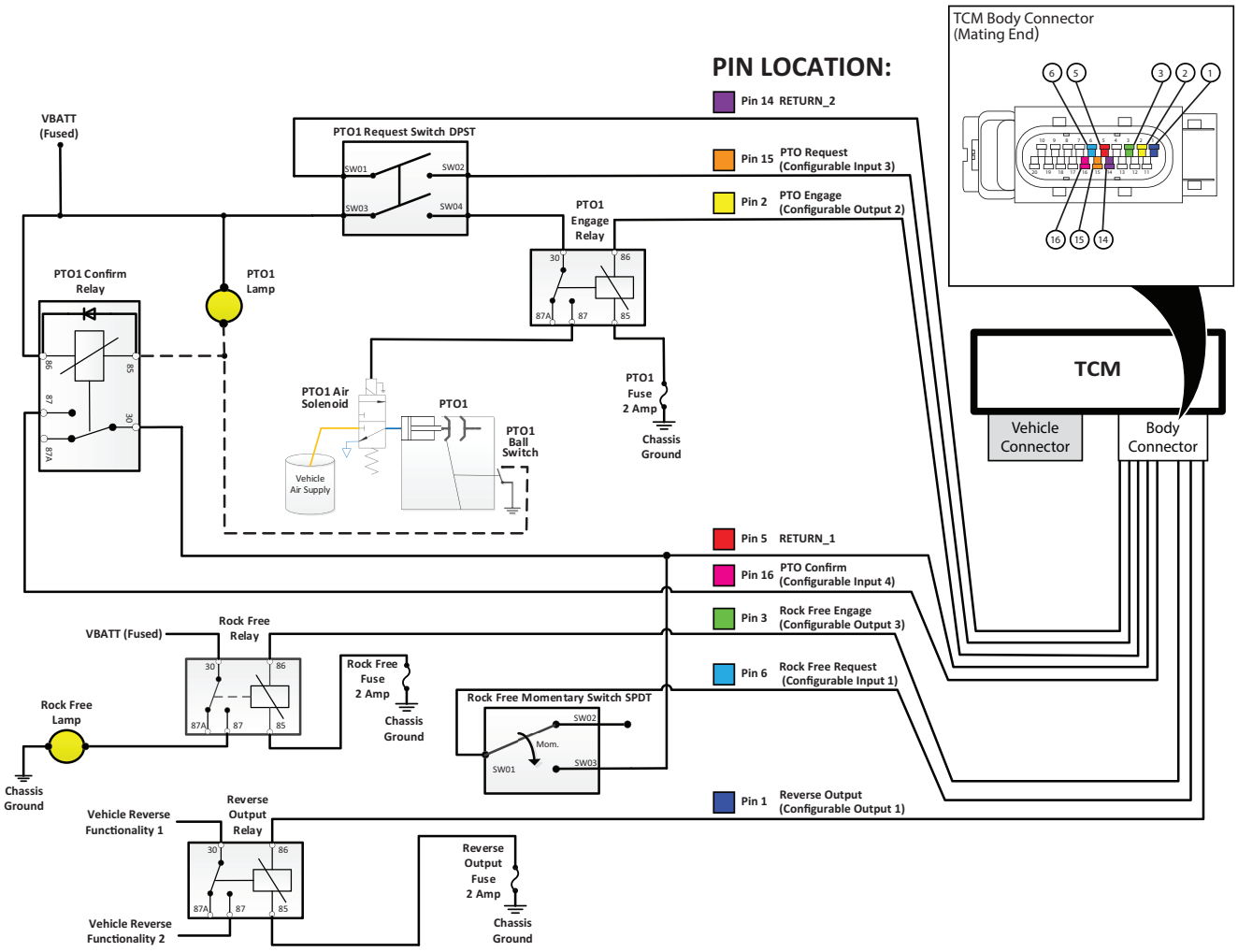
Input / Output Calibration Package 7

PTO 1 + Rock Free Mode + Secondary Configuration Mode



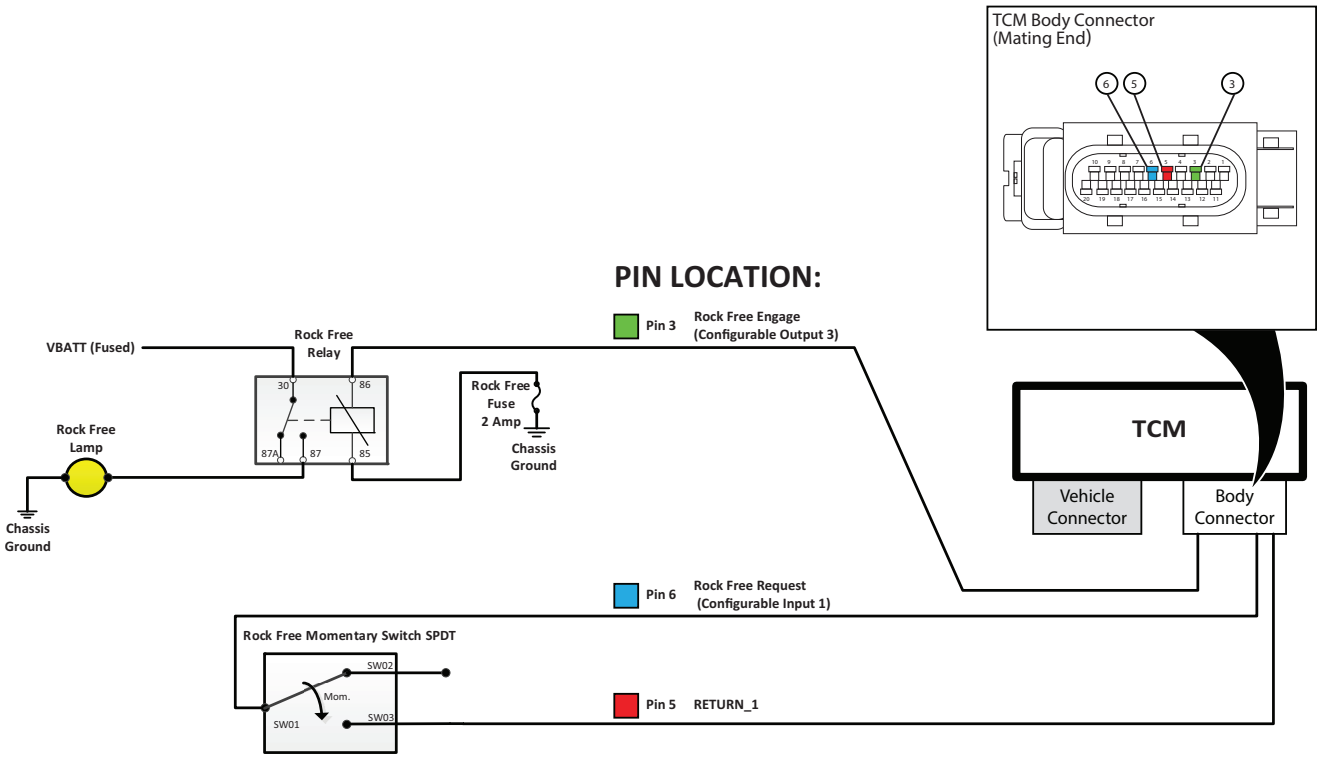
Input / Output Calibration Package 8

PTO 1 + Reverse Output + Rock Free Mode



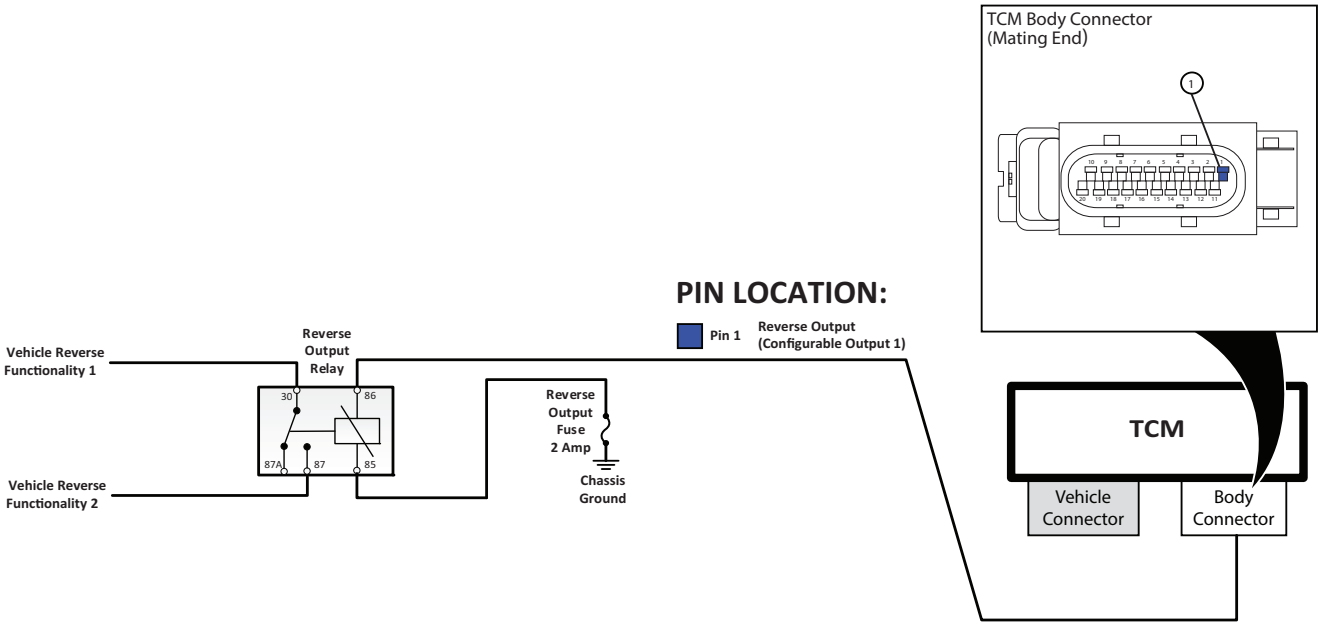
Input / Output Calibration Package 9

Rock Free Mode



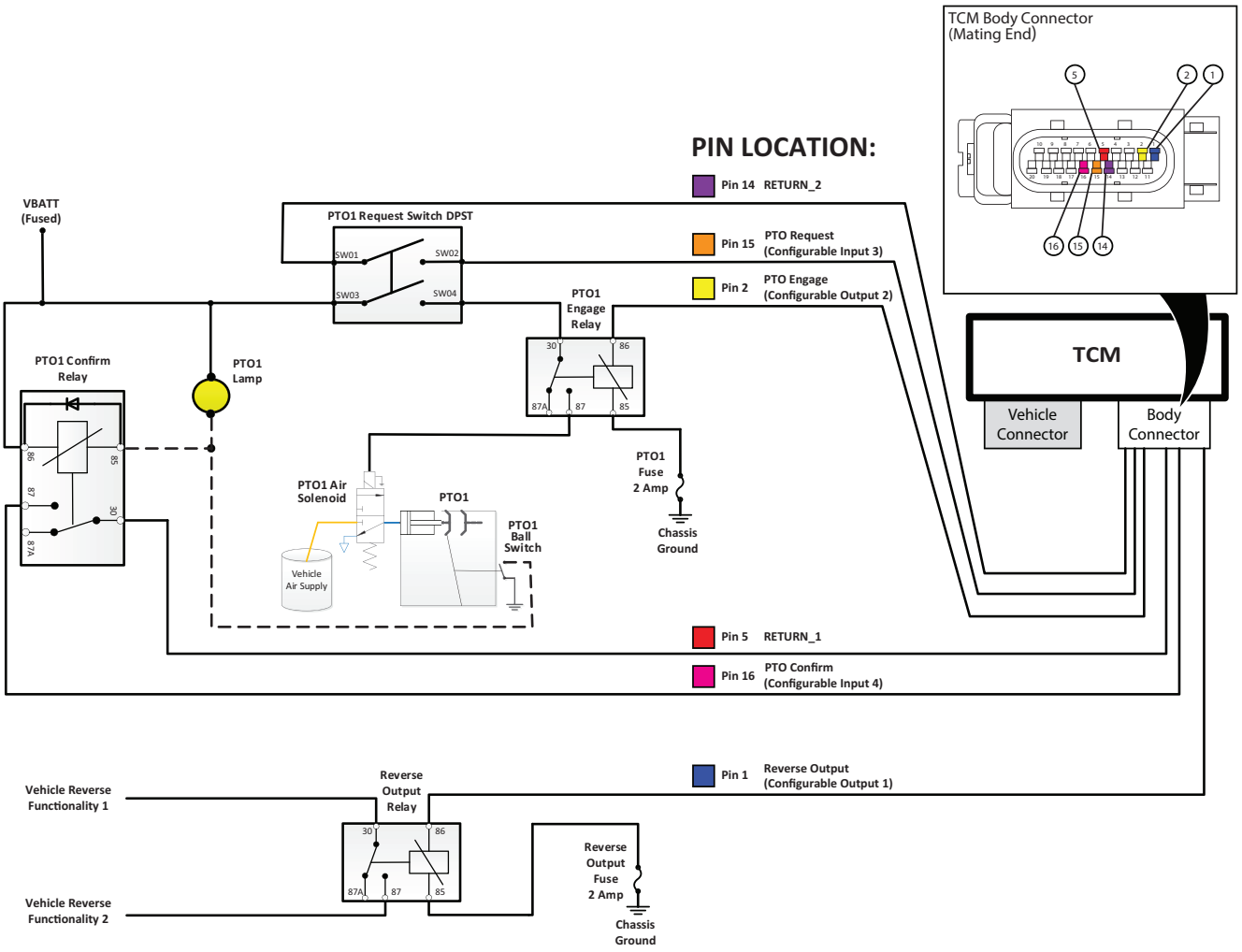
Input / Output Calibration Package 10

Reverse Output



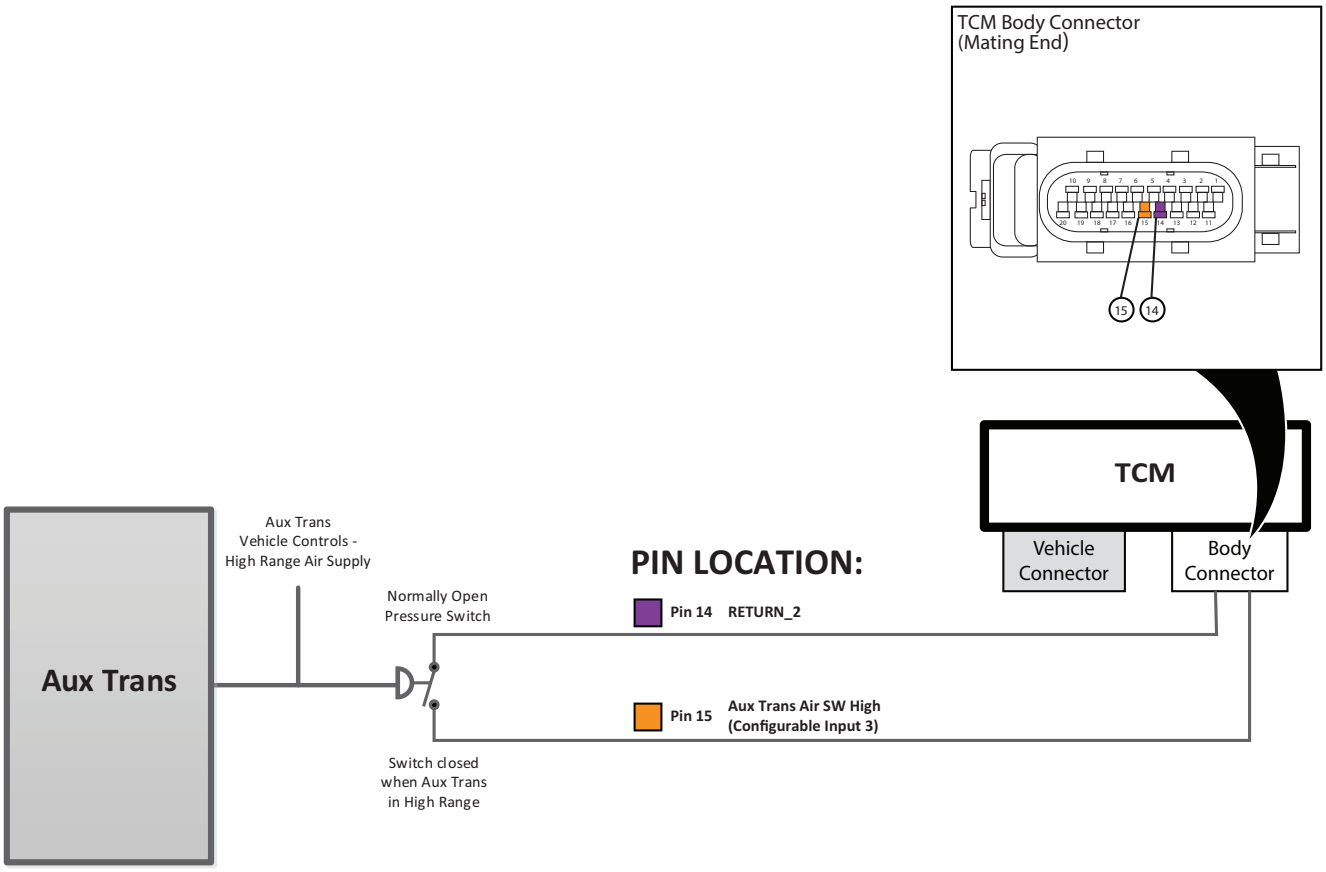
Input / Output Calibration Package 11

PTO 1 + Reverse Output



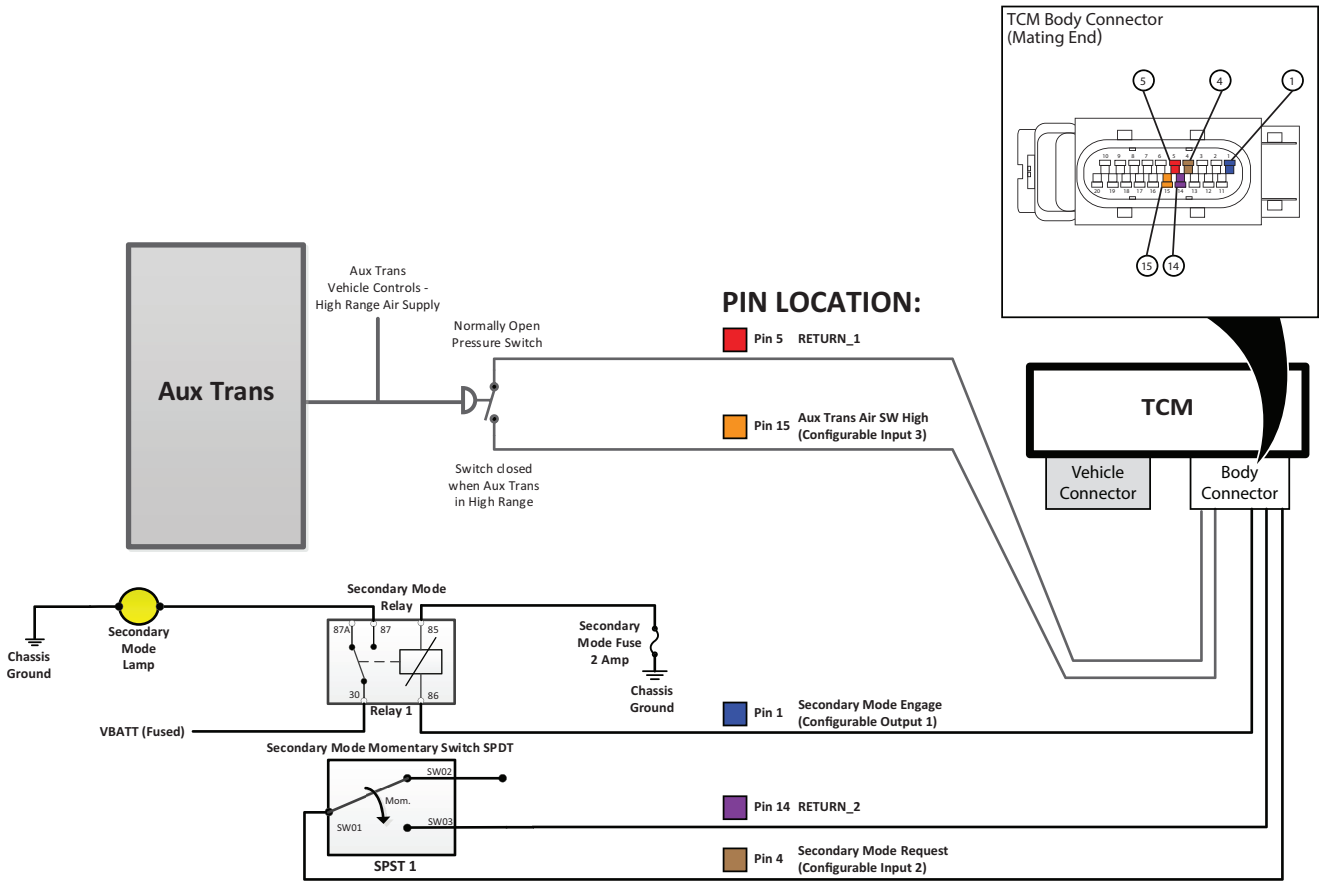
Input / Output Calibration Package 12

Aux Trans



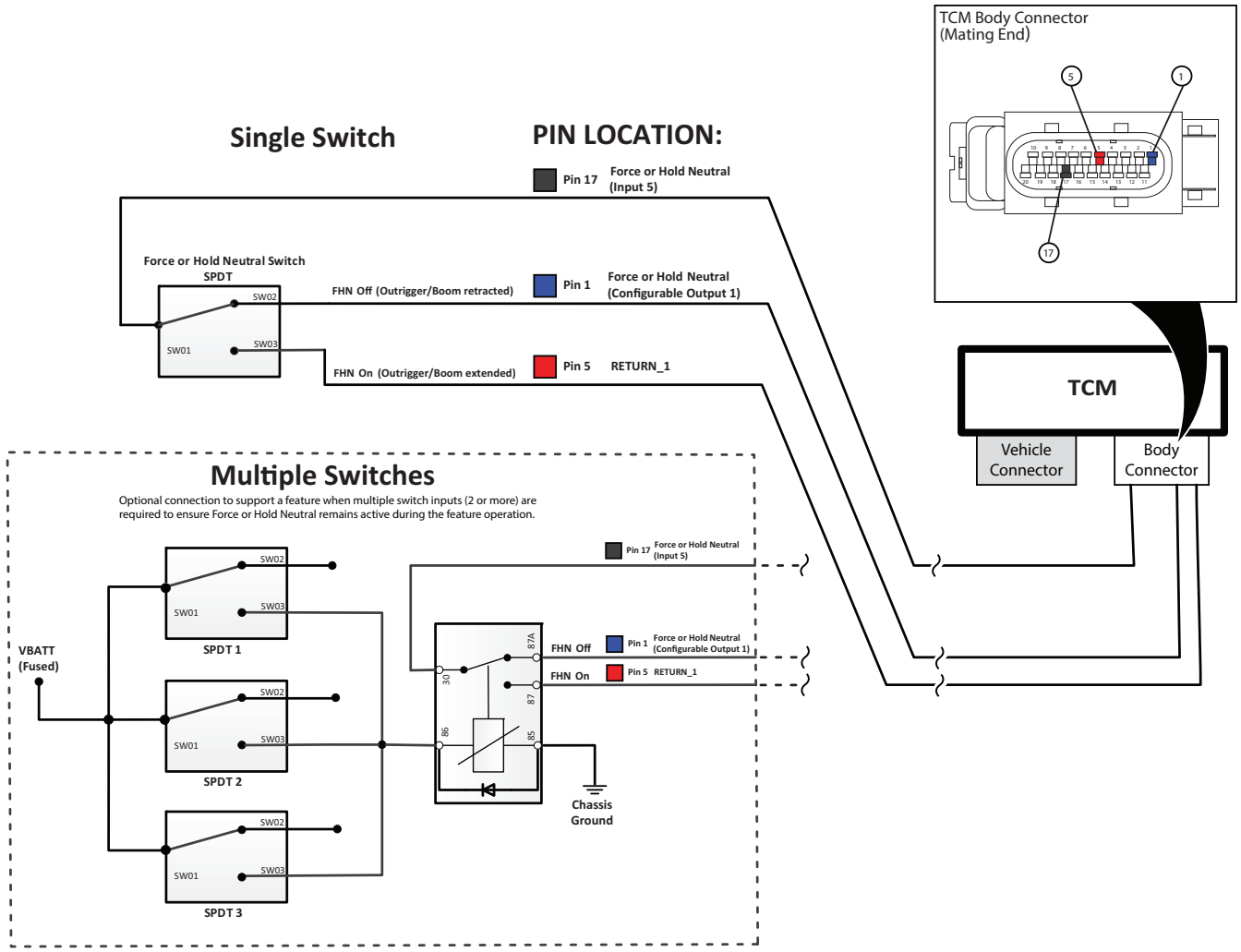
Input / Output Calibration Package 13

Aux Trans + Secondary Shift Mode



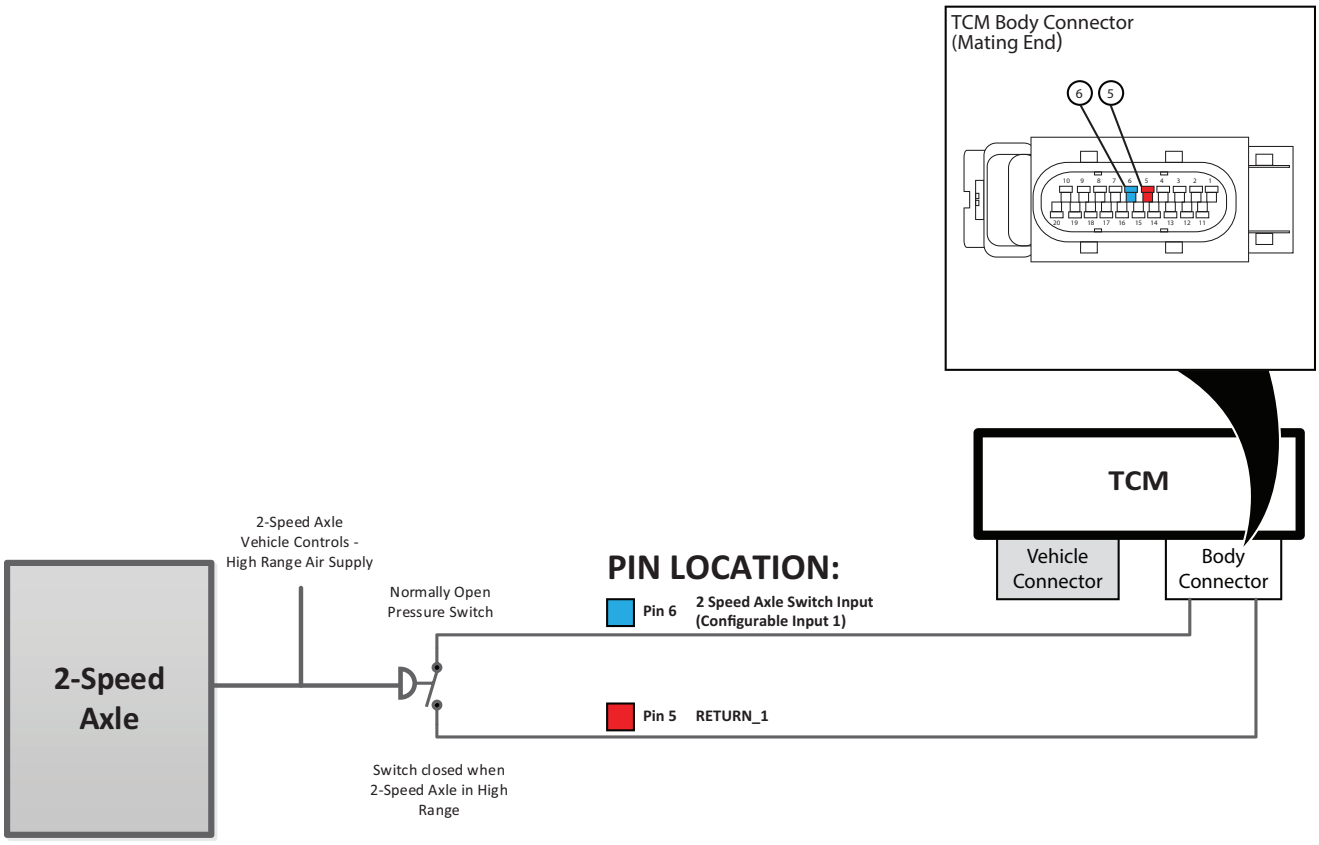
Input / Output Calibration Package 14 & 15

#14 Force Neutral
#15 Hold Neutral



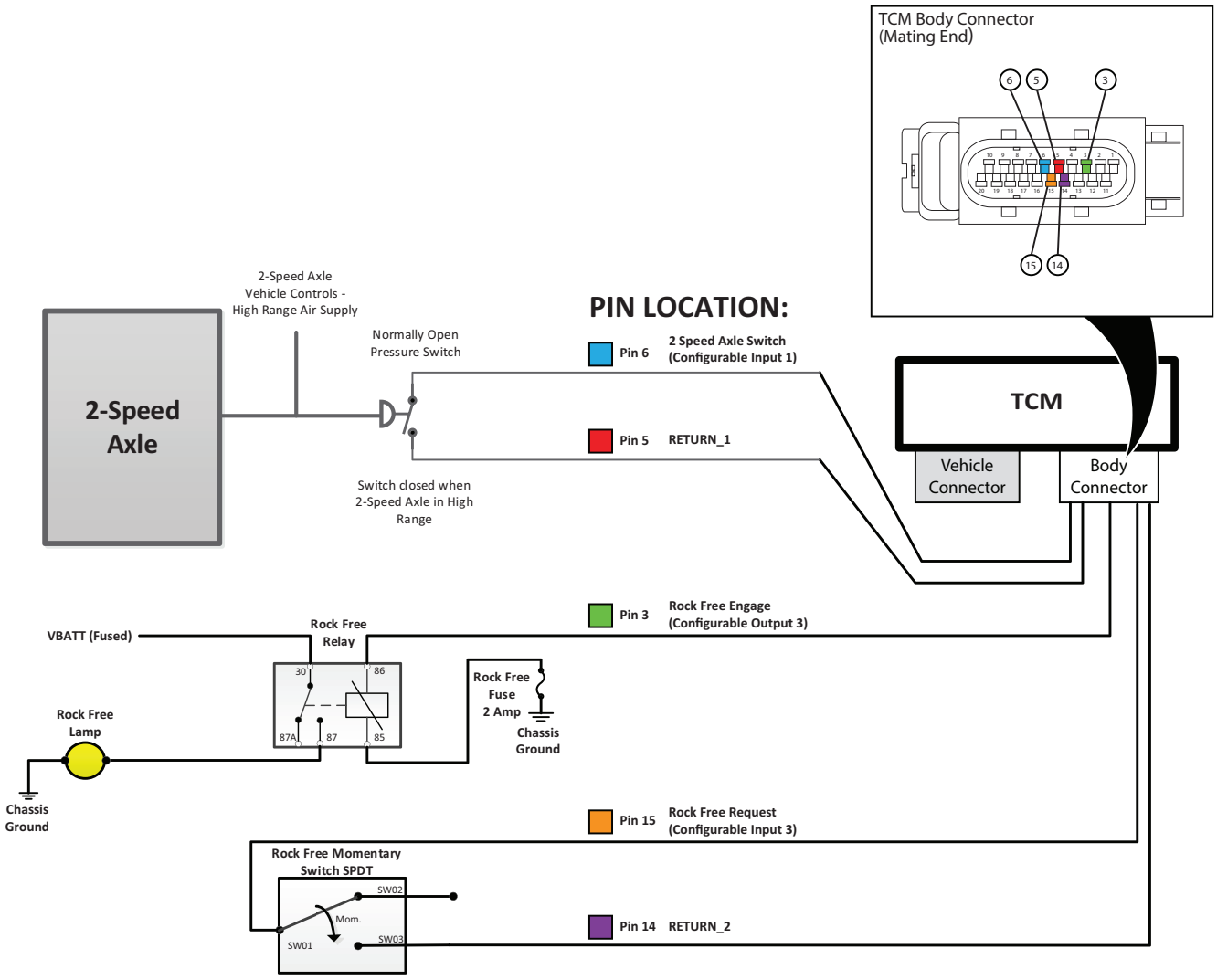
Input / Output Calibration Package 16

2-Speed Axle



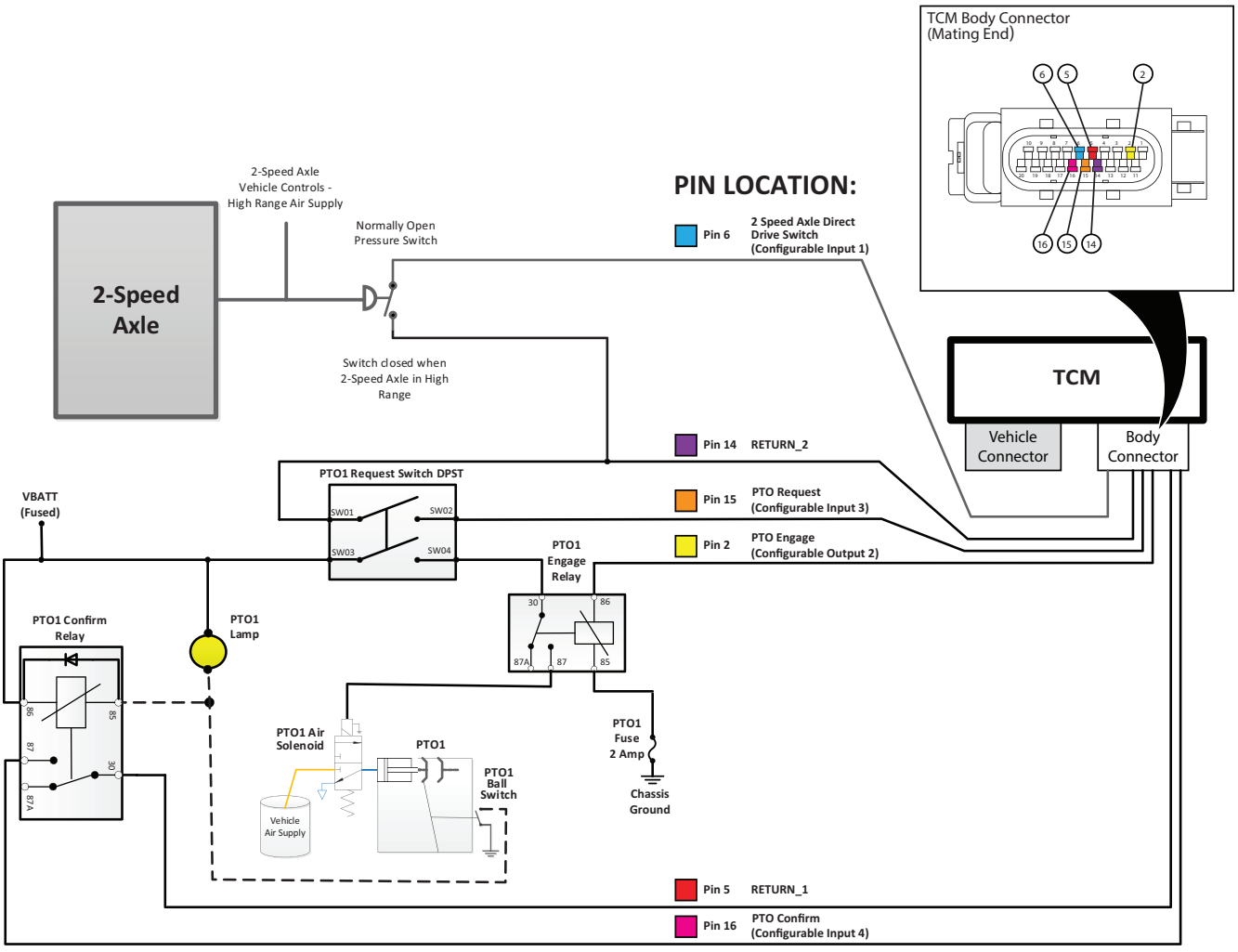
Input / Output Calibration Package 17

2-Speed Axle + Rock Free Mode



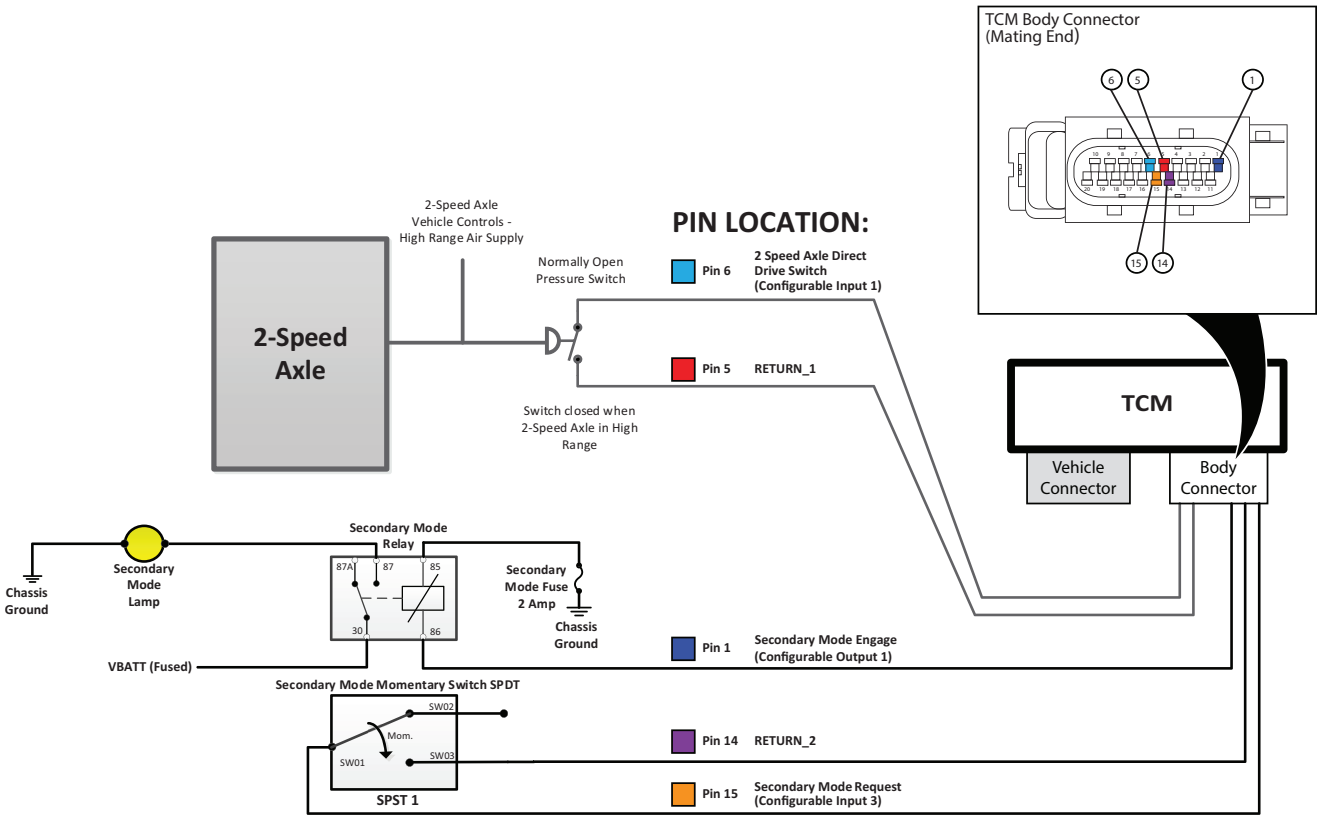
Input / Output Calibration Package 18

PTO 1+ 2-Speed Axle



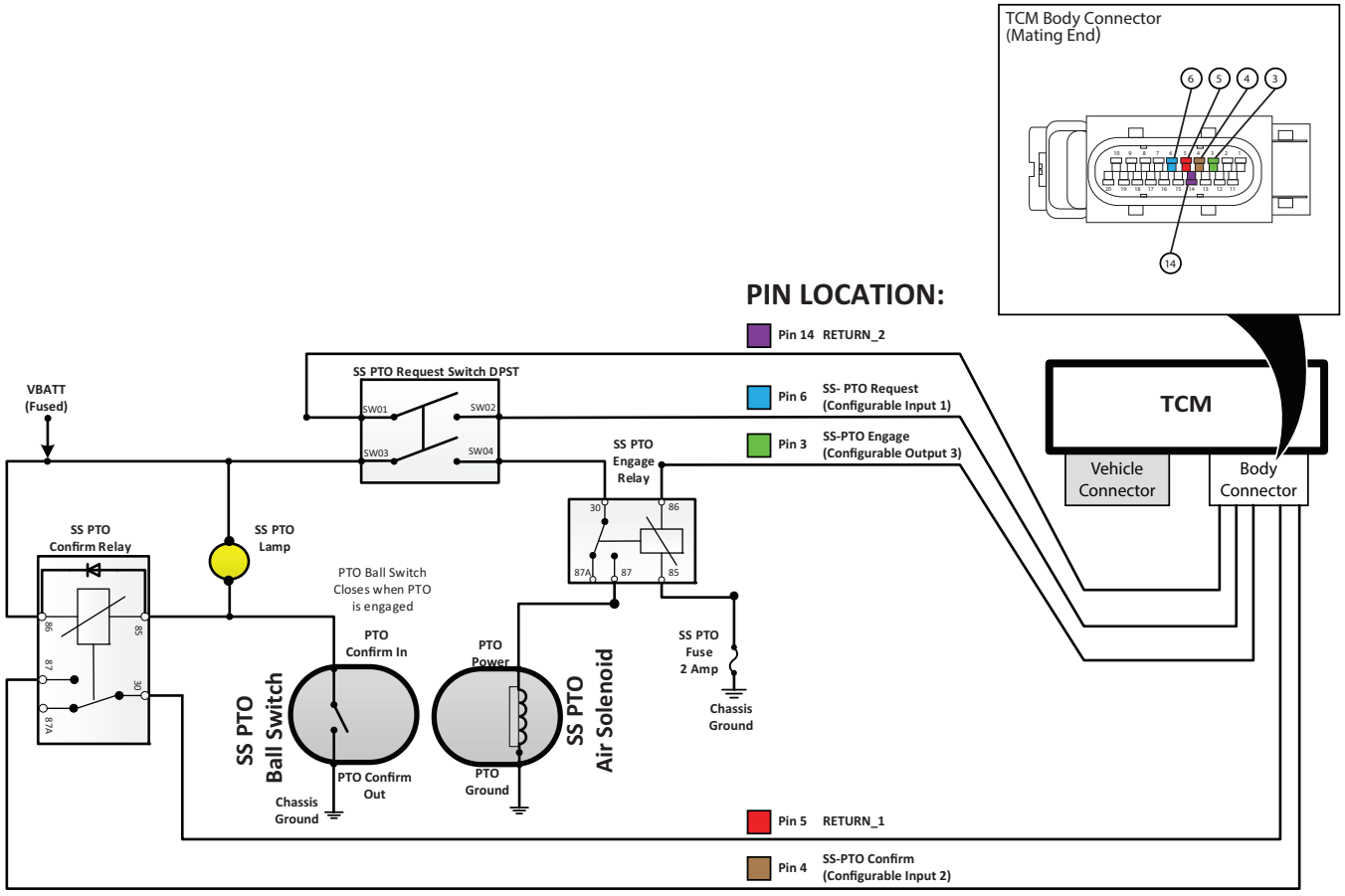
Input / Output Calibration Package 19

2-Speed Axle + Secondary Shift Mode



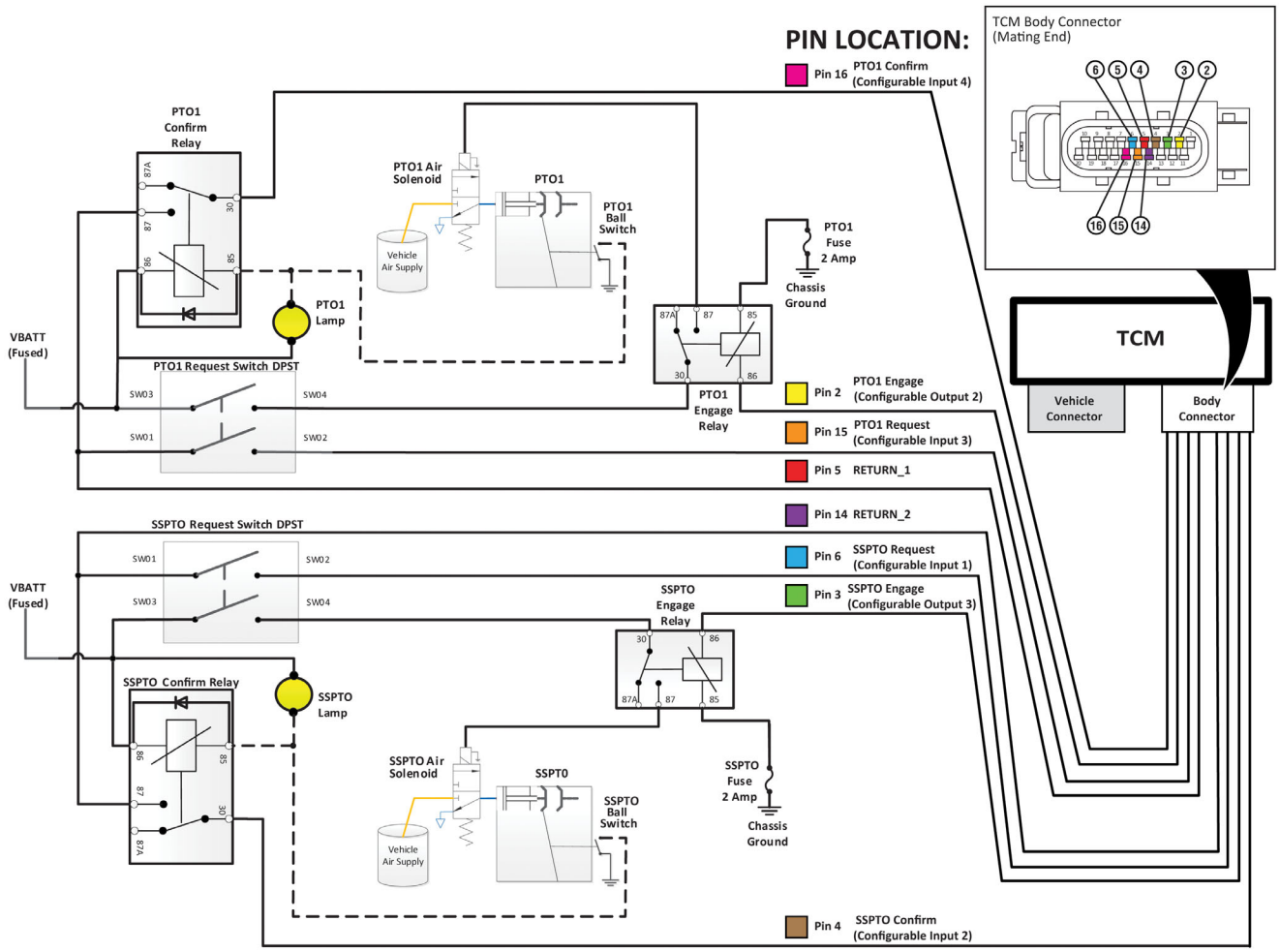
Input / Output Calibration Package 20

SSPTO



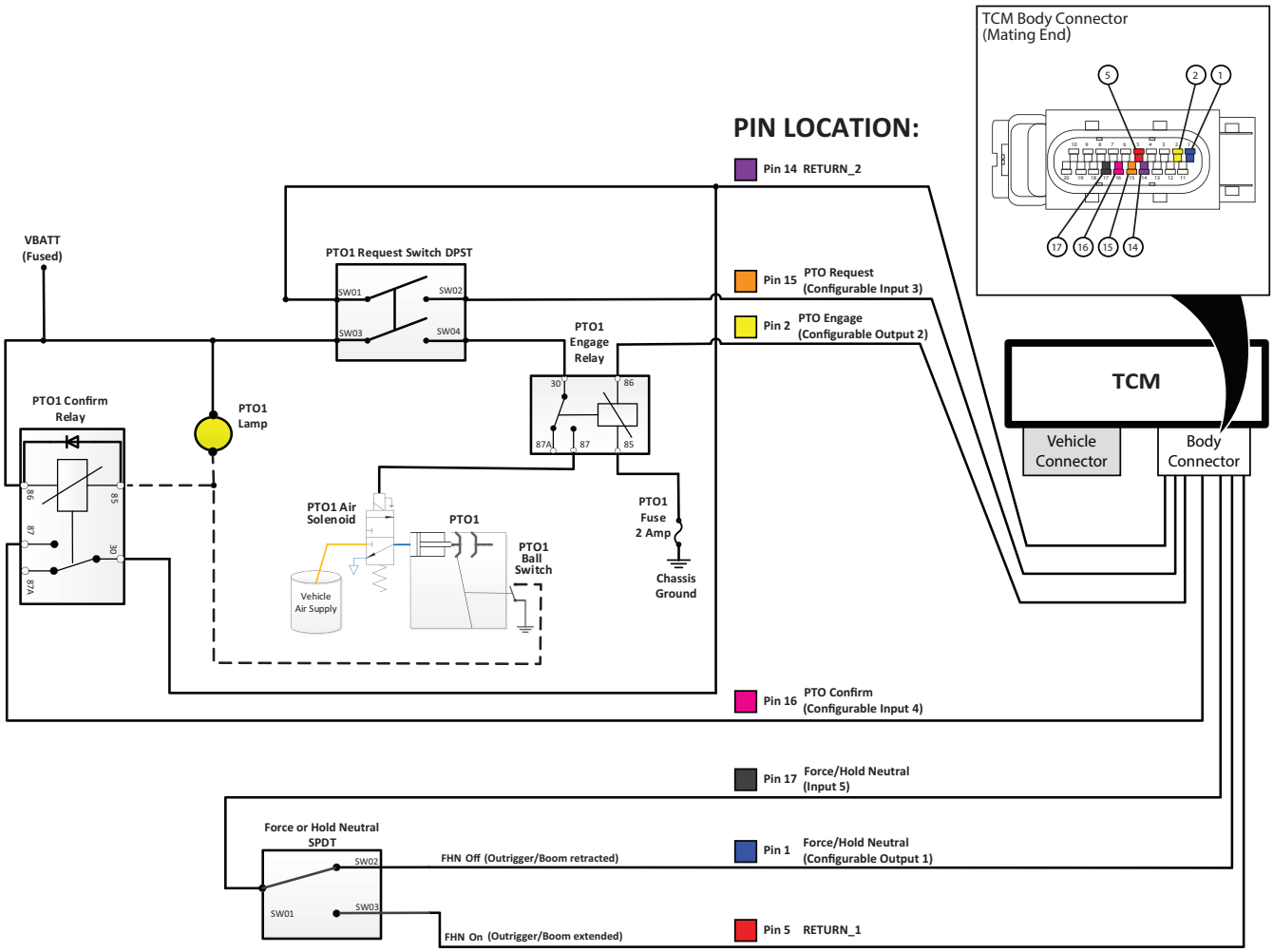
Input / Output Calibration Package 21

PTO 1 + SSPTO



Input / Output Calibration Package 22 & 25

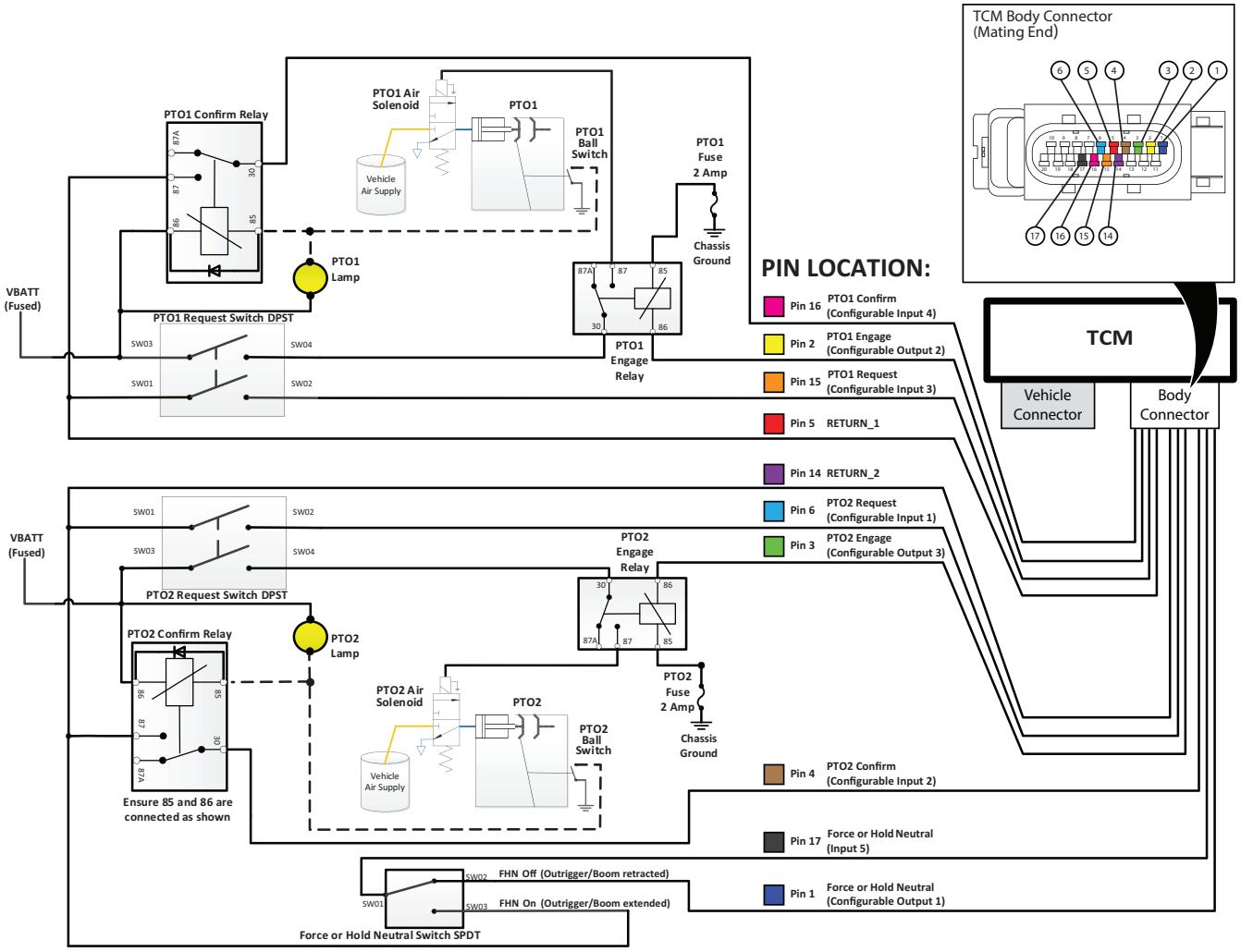
#22 PTO 1+ Force Neutral
#25 PTO 1+ Hold Neutral



Note: Refer to I/O Package #14 and #15 for FHN Multiple Switch Schematic

Input / Output Calibration Package 23 & 26

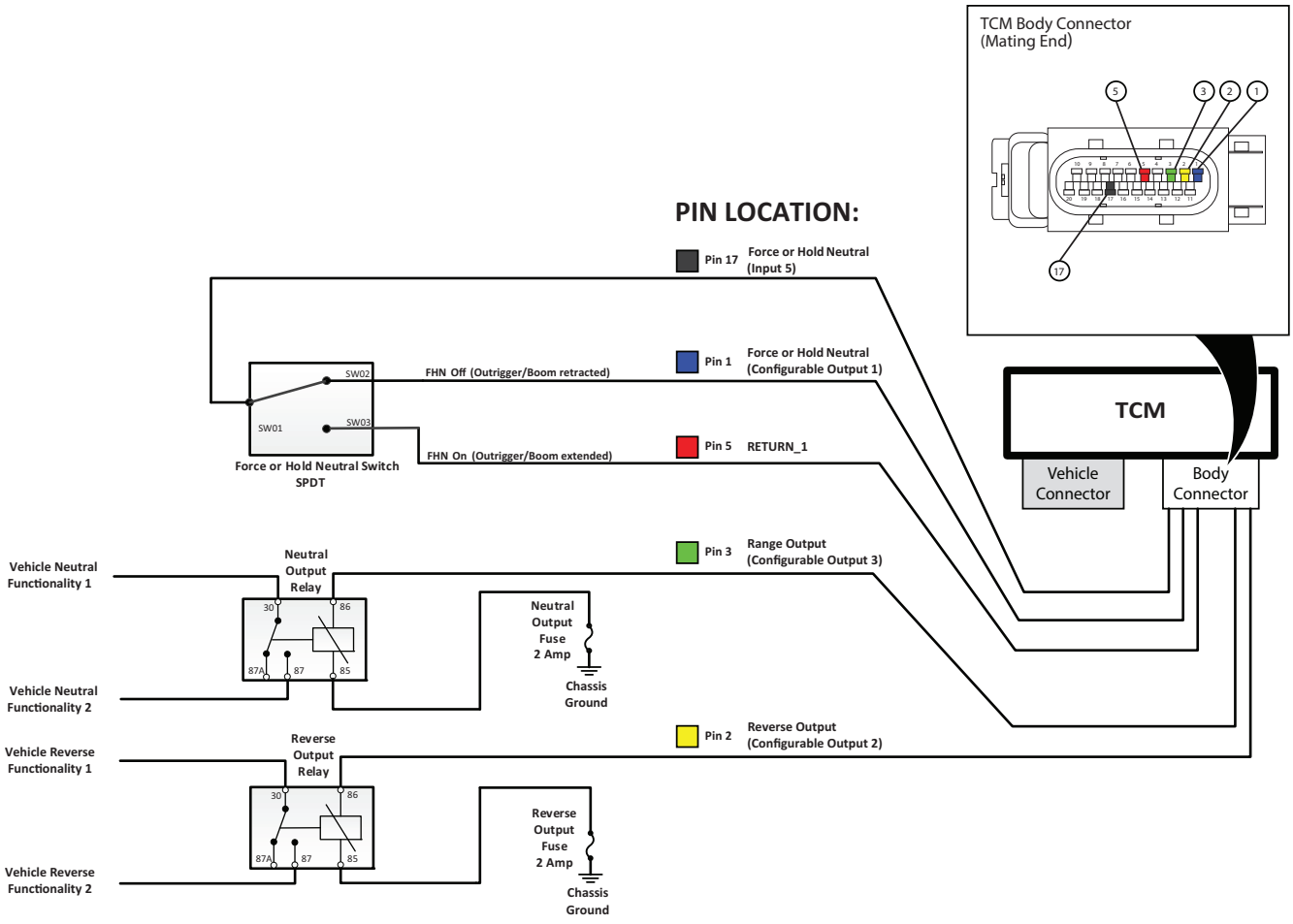
#23 PTO 1 + PTO 2 + Force Neutral
#26 PTO 1 + PTO 2 + Hold Neutral



Note: Refer to I/O Package #14 and #15 for FHN Multiple Switch Schematic

Input / Output Calibration Package 24 & 27

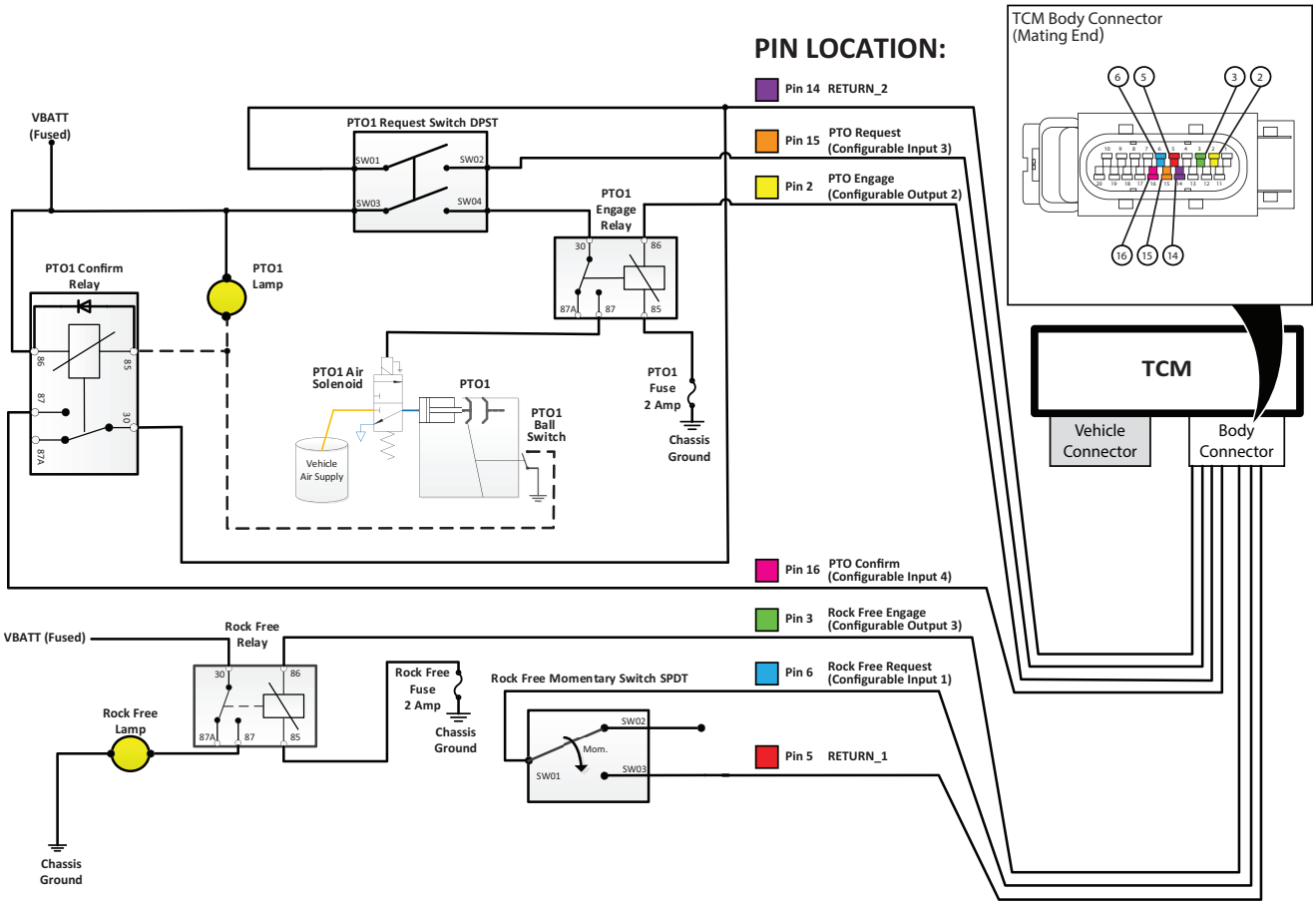
#24 Force Neutral + Reverse Output + Neutral Output
#27 Hold Neutral + Reverse Output + Neutral Output



Note: Refer to I/O Package #14 and #15 for FHN Multiple Switch Schematic

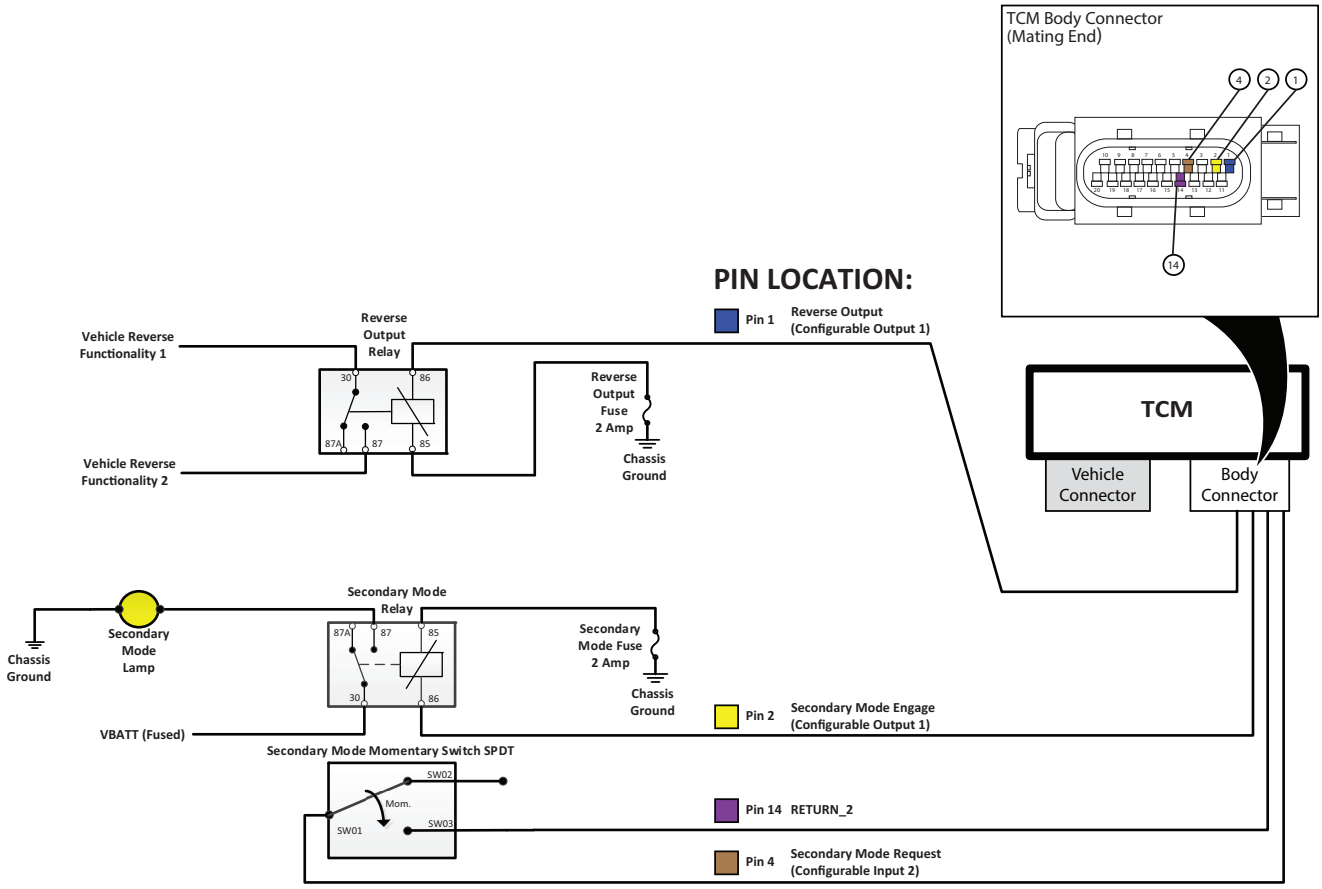
Input / Output Calibration Package 29

PTO 1 + Rock Free Mode



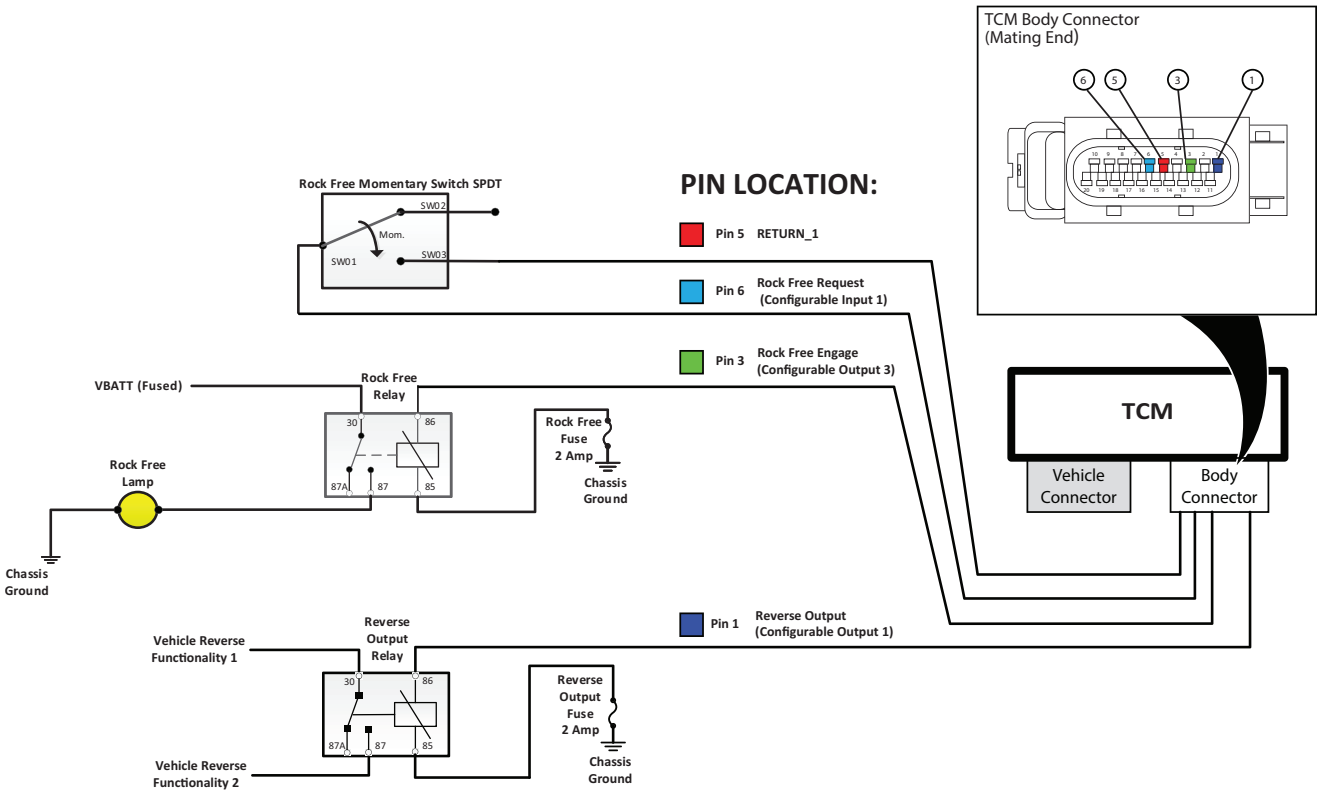
Input / Output Calibration Package 30

Reverse Output + Secondary Mode



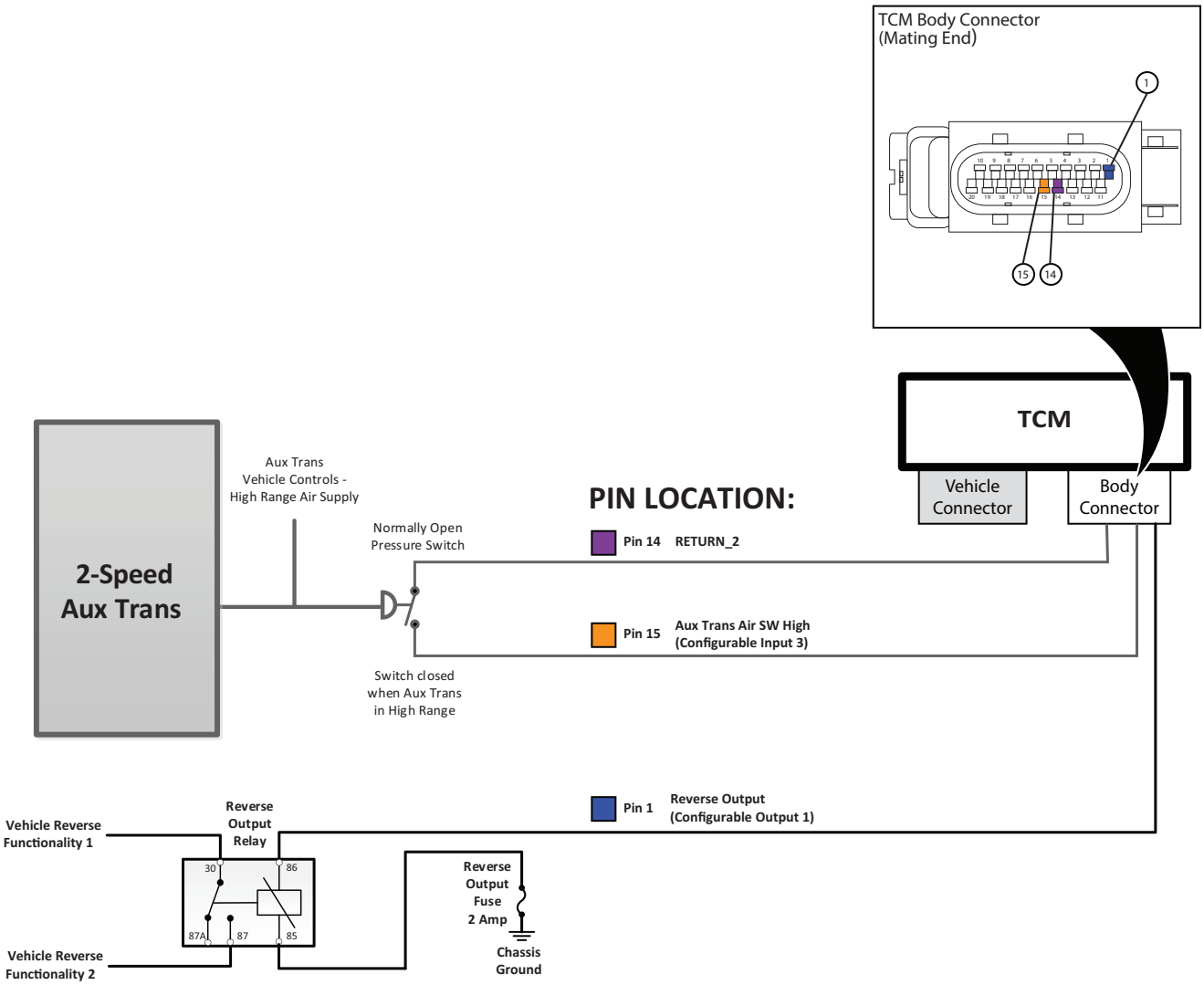
Input / Output Calibration Package 31

Reverse Output + Rock Free Mode



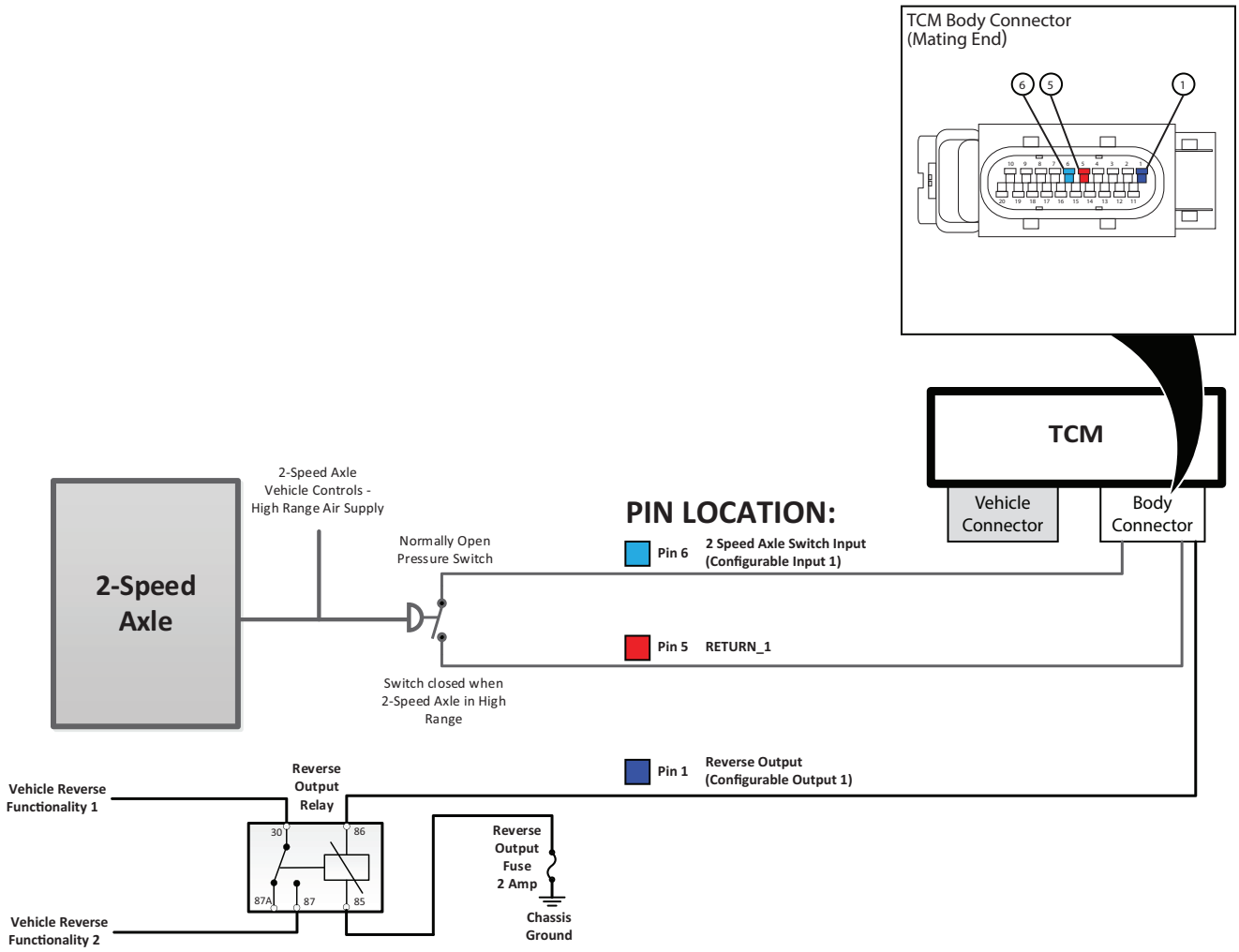
Input / Output Calibration Package 32

2-Speed Aux Trans + Reverse Output



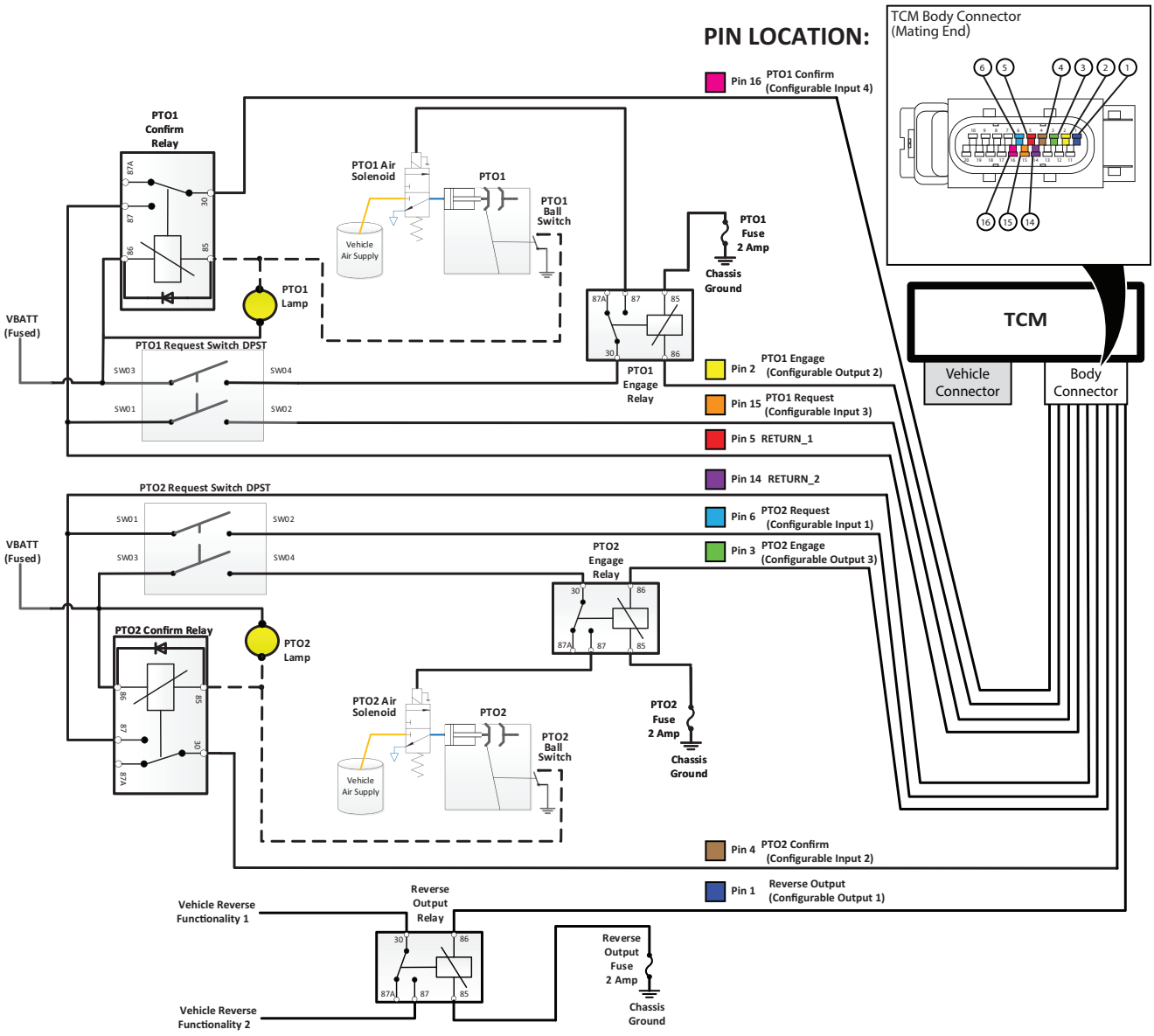
Input / Output Calibration Package 33

2-Speed Axle + Reverse Output



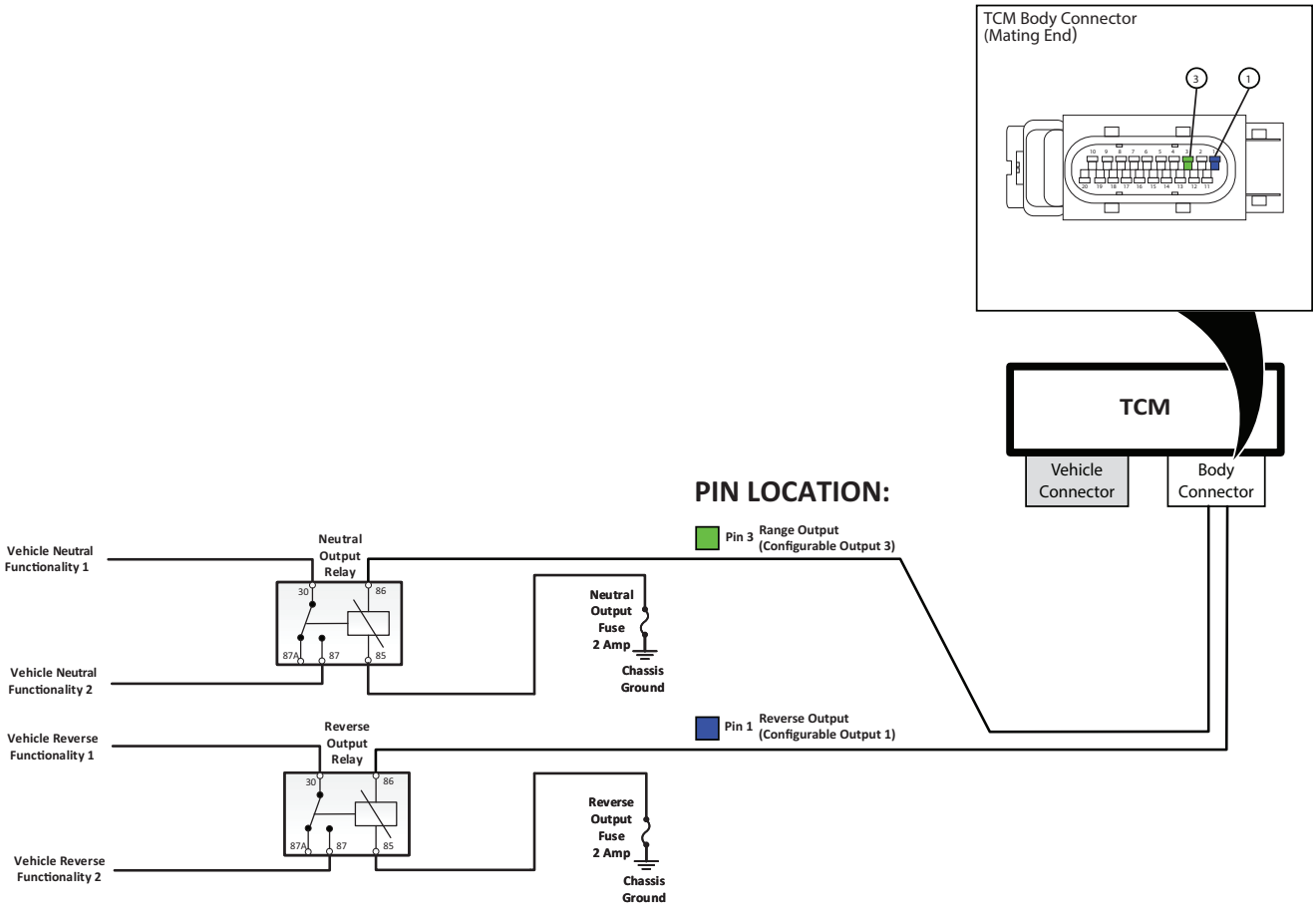
Input / Output Calibration Package 34

PTO 1 + PTO 2 + Reverse Output



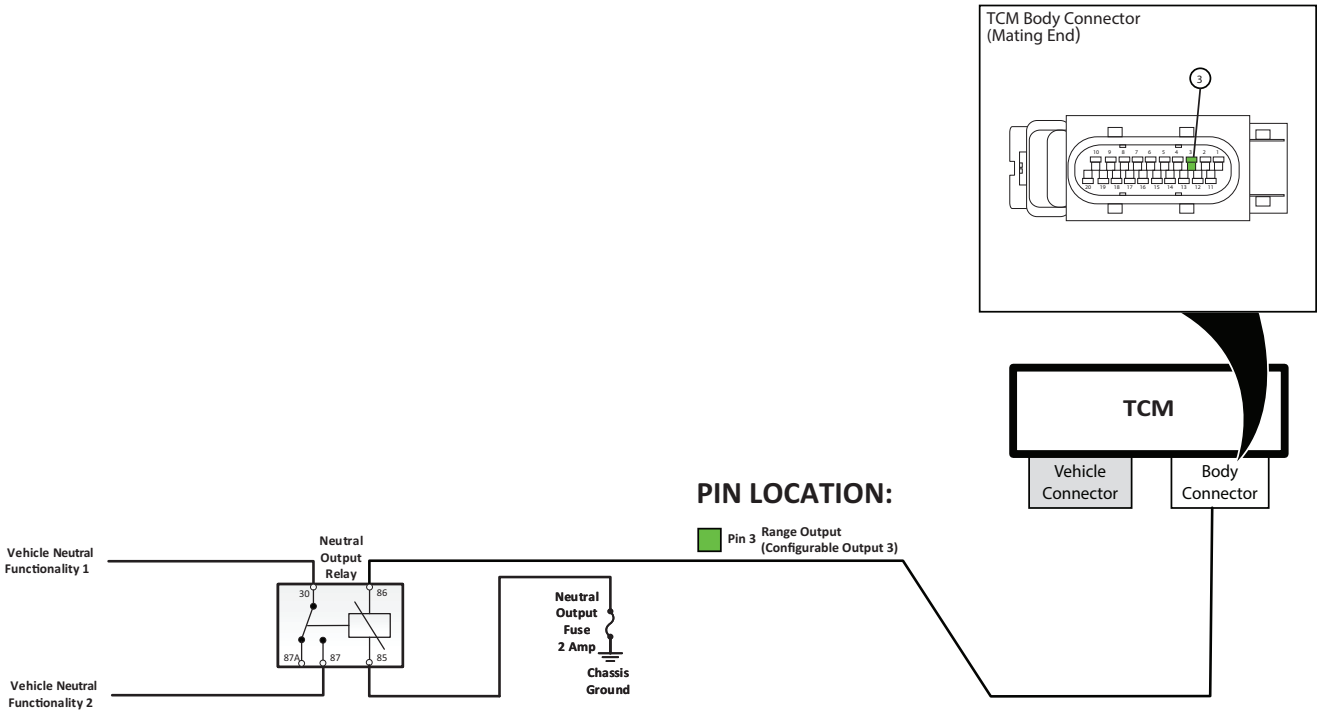
Input / Output Calibration Package 35

Reverse Output + Neutral Output

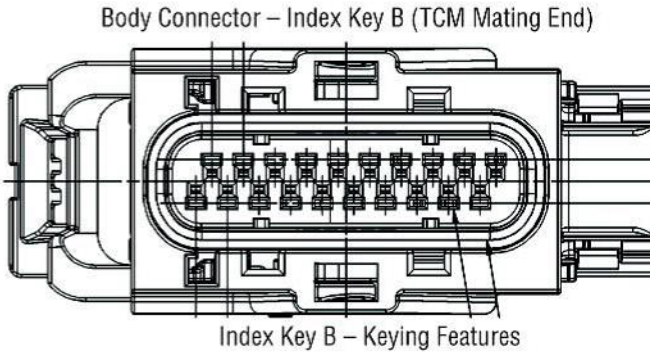


Input / Output Calibration Package 36

Neutral Output



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	Plugged (not used)
B-18	18	Plugged (not used)
B-19	18	Plugged (not used)
B-20	18	Plugged (not used)

Suggested parts for TCM body connector

Component	Delphi Part #	Quantity
Connector Body	13976573	1
Terminal	15471370	20
Secondary Look	15366676	1
Connector Position Assurance (CPA)	15357145	1
Cable Seal	15305351	20
Back shell Cover	15476351	1

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

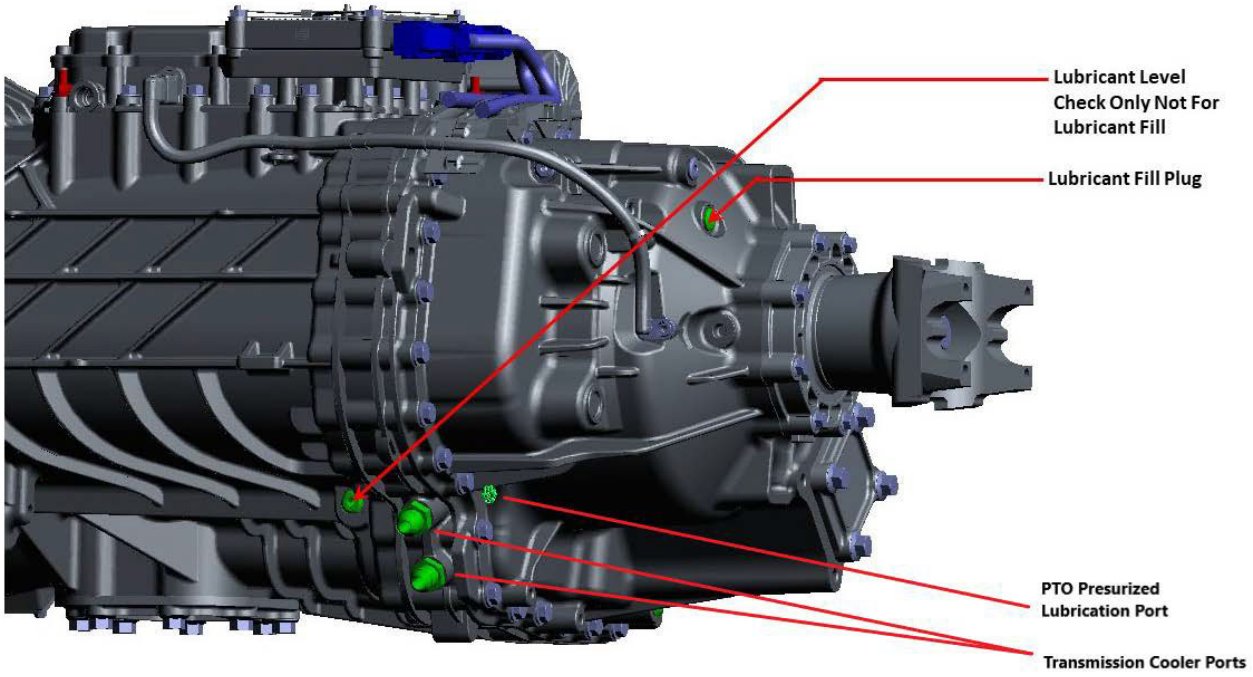
Endurant XD Series transmissions shall be filled with lubrication using a fill hole located at the top rear of the transmission rear case.

- 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).

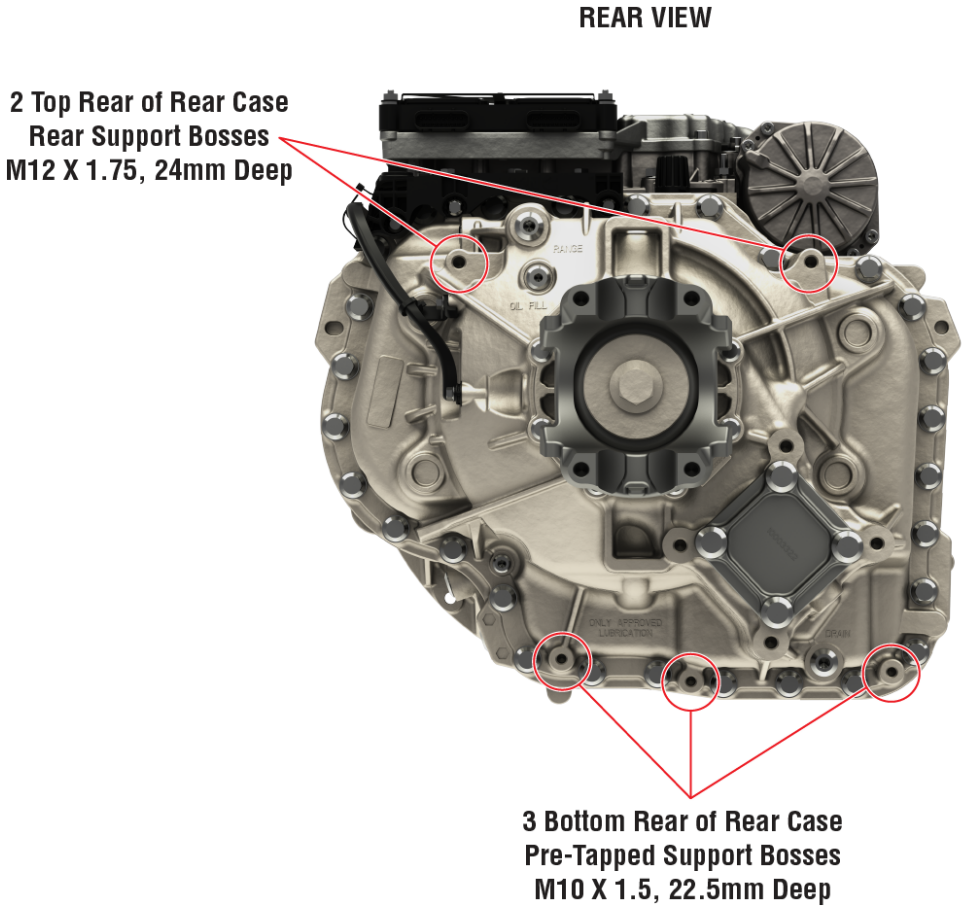
TRF1 - Transmission Oil Temperature 1

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

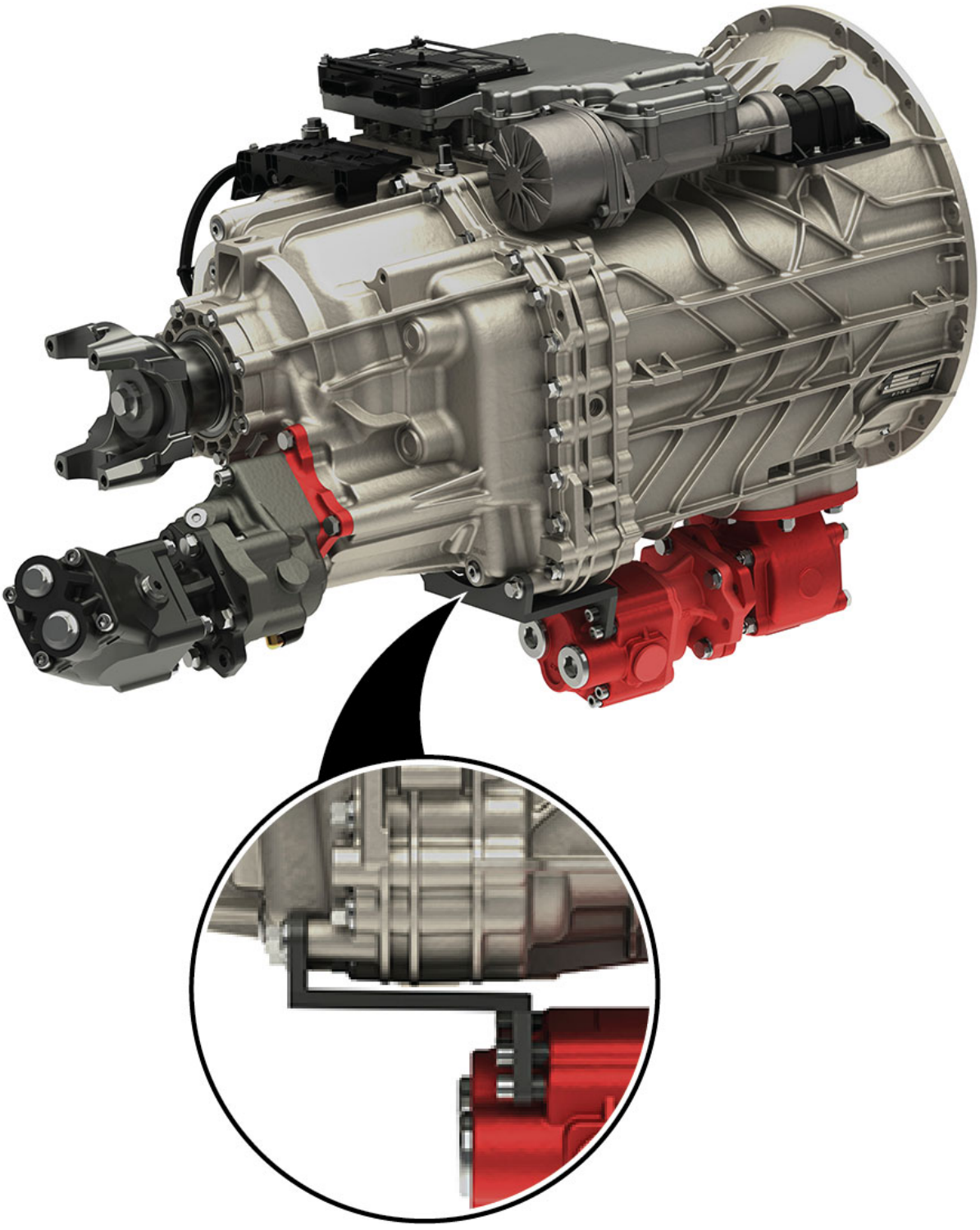


Use only Eaton approved support mounting locations. Not using the proper location could result in transmission damage.

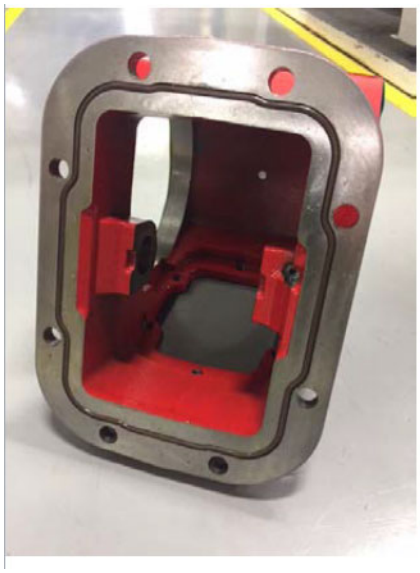
Note: Lifting eyes may be removed after transmission is installed to the engine for installation of additional brackets/clips.

Follow PTO manufacturers guidelines for support requirements of their PTO.

Example PTO Support Bracket:



Endurant XD Series PTO Sealing Configuration Examples:



Chelsea: Push in place elastomer O-ring type seal	Muncie: Steel gasket with Edge molded elastomer seal	Bezares: Steel gasket with raised seal surface and elastomer coating on entire gasket surface

All PTO manufactureres 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)284-7721

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 2023	Nomenclature changes, Warnings & 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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