

TECH TIP

Group:	0-GENERAL
Bulletin No:	TT-15-027
Issue Date:	9-16-2015

CONVENTIONAL TRUCK PTO INSTALLATION INSTRUCTIONS

SUBJECT VEHICLES: 2011MY-2016MYHino Conventional trucks equipped with an Allison Transmission

Note: This tech tip is provided as technical information and is not authorization for a warrantable repair.

OVERVIEW: The information contained below outlines scenarios that may not account for all configurations and should be utilized as a general guideline to assist in the integration of interfaces to Hino vehicles prior to assembly and is not intended to be utilized for diagnosis of an installed system or for repair information.

Disclaimer: Hino Motor Sales U.S.A Inc. is an incomplete vehicle manufacturer. It is the responsibility of the final stage manufacturer that the complete vehicle complies with local, state, and federal requirements. Additionally, the final stage manufacturer is responsible to understand all systems and controls to power and operate equipment that interface with Hino vehicles. This should include but is not limited to the design, utility, application, safe operation, performance, durability, controls, installation, and parts availability.

Hino Motor Sales with approval from our partner Allison Transmission references specific Allison Transmission reference materials and other information in this document. The reference information in this document will be updated periodically, but may not include the latest information. Many of these reference materials are living documents and should always be referenced from their original source each time an application is considered to ensure the latest and most up to date information is captured.

Recommended special tools: Below is a list of special tools that may be required for the installation and configuration of the PTO to the transmission.

Hino DX software – Required to change Engine Control Module (ECU) parameters. Please visit hino.com and navigate to the service tab, then to the diagnostics section for more information.

Allison DOC software – Required to modify Allison Transmission programming or access to a Allison distributor/repair facility with programming capability.

Appropriate Torque Wrench – different PTO manufacturers use different fasteners and have their own clearance constraints. A special torque wrench may be necessary for the installation.



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Recommended supporting literature: Below is a list of recommended supporting literature to review prior to design and installation of a PTO. This is not a complete list due to many of the documents reference other documents based on application. The below list is a high level overview of fundamental information that needs to be considered when designing and installing a PTO system on a Hino vehicle with an Allison Transmission. The body builder guide can be found at hino.com. The Allison Transmission reference documents can be found on the Allison Transmission Extranet. If you do not have access to the Extranet, contact your Allison Transmission representative. For information related to the PTO, driven component, and/or related system manufacturers, contact the respective manufacturer for supporting documents.

- Hino Motor Sales Body Builder Guide
 - Chapter 7 Includes electrical interface information.
 - Chapter 11 includes PTO interface information.
 - Chapter 12 includes wiring schematics.
- Allison Transmission Technical data – PTO Provision
- Allison Transmission Technical data – Transmission Control Systems
- Respective PTO manufacturer technical information
- Respective driven component technical information
- Technical information for any related equipment attached or impacted by a power take off system



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Power take off (PTO): A PTO is a piece of equipment attached to the drive train used to power auxiliary equipment.

Transmission PTO Power flow: Allison Transmissions installed in current Hino Motors Conventional Models are equipped with a 2000 or 3000 series transmission. It is important to understand the transmission PTO power flow. A brief summary of these are outlined below, but are covered in greater detail in the recommended supporting literature above. If the PTO is used in gear, the PTO will be affected each time there is a shift.

2000 series: The PTO drive gear is turbine driven and if the transmission is not in lockup mode (1:1) the PTO drive gear is less than engine speed.

3000 series: The PTO drive gear is a large drive gear driven by the engine and is turning whenever the engine is running.

Types of power take off's: There are many different types of power take off's and a PTO is one part of a larger system that requires a thorough understanding of electrical, mechanical, and hydraulic SYSTEMS at a minimum. Failure to understand the entire system can lead to a system that may not function to unsafe operation and/or major component failure.

Controls: PTO Interface allows for certain operational controls to be established based on application requirements. There are numerous ways to control and operate a PTO system. This needs to be considered when the mission of the completed vehicle is defined. For transmission mounted clutch type PTO's controls, often times these require raised transmission pressures for proper operation and how to accomplish this is covered in the reference documents listed above. Auxiliary truck interface requirements such as engine shutdown or other auxiliary inputs or controls, can also be found at the reference material listed above. Hino trucks are equipped with 5th generation Allison 3000 series transmission and are equipped with vocational package 223. The 2000 series is equipped with vocational package 354. If a different package or function is required other than what is standard, please contact the final stage manufacturer or your local Allison representative for assistance. The programming may have to be altered and wires may need to be added from the transmission control unit to obtain the desired functionality. What TCM drop outs are available on a Hino truck are limited and vary based on configuration. Drop outs can be added if needed. This information is covered in the recommended supporting literature.



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In Cab Preset Stationary Controls: The following is one example of a general guide to operate auxiliary equipment from inside the cabin of the vehicle at a pre-set RPM level.

Example 1: A Hino model 338 with an Allison 3000 series transmission has one transmission mounted clutch type PTO that requires raised pressure for the installed operation. An OEM installed on/off switch has been added inside the cab and is supplying 12V to the 143 wire of the transmission control module and PTO Switch #1 ECM interface. The vehicle will be operating in stationary mode at 1300RPM. Due to a requirement by the company that owns the vehicle, they also would like the accelerator pedal not to function while the vehicle is in PTO mode.

Configuration and RPM Control:

Utilizing the Hino DX software, access the customization tab for the ECM and make the changes to the parameters as outlined immediately below. Reference tables one and two at the end of this document for DX parameter information.

<u>Parameter</u>	<u>Original Value</u>	<u>New Value</u>
279	0	1300
224	0	1

Utilizing Allison DOC software, any relevant customer modifiable constants are changed. In the example below there are CMC's that require SEM/LRTP and this is only available on the 2500 series transmission with 5th generation controls.

See **Figure 1** below for more information on the PTO Drive Interface. One for more specific information on the connections to the TCM and the function of the interface. **It is important to note, there are a number of these configurations often times for each input/output function as well as other important interface and safety information contained in each document. This information should be verified against the live document from Allison Transmission for the specific application at the time of review and installation.** Figure 1 on the following page is just one example that may or may not work for the application.



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Figure 1

PTO DRIVE INTERFACE 1

INPUT C1: WIRE 143 / OUTPUT G1: WIRE 130

APPLICABLE TRANSMISSIONS: 3000 Product Family, 4000 Product Family

DESCRIPTION: This function is requested when wire 143 is switched to send power to the TCM. The TCM activates the PTO Drive Interface Output by switching power to wire 130 when the following conditions have been met:

- The function has been requested
- Throttle position is low
- Engine speed is within Customer Modifiable Constant limits
- Output speed is within Customer Modifiable Constant limits

When this function is activated, the TCM disables the variable modulated main pressure feature in the transmission, resulting in transmission operation at full main pressure.

NOTE: Input C or the J1939 Datalink equivalent **MUST** be integrated into the design and installation of the PTO control system if more than 125 psi transmission main pressure is required. Otherwise, variable modulated main pressure could potentially reduce main pressure below the minimum pressure required by the PTO clutch control.

USES:

- Permits operator to control engagement and disengagement of the PTO with a switch.
- Provides inhibits for PTO engagement based on engine speed or transmission output speed
- Provides for automatic disengagement of PTO based on engine speed or transmission output speed
- Provides a mechanism to disable the modulated main pressure feature in the transmission.

CUSTOMER MODIFIABLE CONSTANTS:	Default Value	Allowable Range	Units
• Maximum engine speed for PTO engagement ⁽¹⁾	900	500 – 2600	rpm
• Maximum engine speed for PTO operation	4000	375 – 5000	rpm
• Maximum output speed for PTO engagement	250	50 – 6000	rpm
• Maximum output speed for PTO operation	300	60 – 6000	rpm
• PTO Torque Limiting (requires SEM/LRTP)	Disabled	Disabled / Enabled	
• PTO Torque Limit	1084	100 – 1084	Nm
• Drive Ratio (Percentage of Engine Speed)	120	75 – 200	percent (%)

The CMCs will be the same for all PTOs that are integrated with PTO Drive Interface 1.

VOCATIONS: Various with usage of PTO

FUNCTION RESPONSE TO TCM POWER INTERRUPTION (power-off, followed by power restored):

Power off: Output (wire 130) is disabled.

Power restored: Output (wire 130) remains disabled until the function is re-requested.

(1) CAUTION: If the PTO is used to drive high inertia equipment (e.g. alternator, blower, chain-driven mechanical devices), the Max. Engine Speed for PTO Engagement should be set as closely as possible to the engine idle speed. Engagement of the PTO at high speed, whether by activation of this function or automatic re-engagement of the function following a disengagement due to overspeed, may cause damage to the PTO system.

WARNING! This schematic shows the intended use of the specified controls feature which has been validated in the configuration shown. Any miswiring or use of this feature which differs from that shown could result in damage to equipment or property, serious personal injury, or death. **Allison Transmission is not liable for consequences associated with miswiring or unintended use of this feature.**



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Configuration and RPM Control: In Cab Preset Stationary Controls: Two PTO's operating at different RPM's:

Example 2: A Hino Model 338 with an Allison 3000 series transmission has two PTO's mounted to the transmission and each PTO needs to operate at different speeds. Two switches have been installed for each PTO. 12 volts is applied to the PTO switch #1 ECM interface when activated and 12 volts is applied to the PTO switch #2 ECM interface when activated. Due to a requirement by the company that owns the vehicle, the PTO's RPM Control should only be able to be operated when the park brake is applied.

Configuration and RPM Control: Utilizing the Hino DX software, access the customization tab for the ECM and make the changes to the parameters as outlined immediately below. Reference tables one and two at the end of this document for DX parameter information.

<u>Parameter</u>	<u>Original Value</u>	<u>New Value</u>
231	0	1
286	0	1100
287	0	1400
232	0	1

In Cab Variable Stationary Controls: The following is a general guide to operate auxiliary equipment from inside the cabin of the vehicle at a variable RPM level.

Example 1: A Hino Model 338 with an Allison 3000 series transmission has one PTO installed. The engine RPM control needs to be carried out with the cruise switches after activation of the OEM installed PTO switch with a maximum engine speed of 1500 RPM. The OEM installed PTO switch will supply 12 volts to the PTO switch #1 ECM interface when activated. The resume switch can now be utilized to increase the RPM's and the set switch can be used to decrease the RPM's.

Utilizing the Hino DX software, access the customization tab for the ECM and make the changes to the parameters as outlined immediately below. Reference tables one and two at the end of this document for DX parameter information.

<u>Parameter</u>	<u>Original Value</u>	<u>New Value</u>
229	0	1
285	0	1500



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In Cab Variable Stationary Controls: Split Shaft PTO/4th Gear Lockup

Example 2: Hino Model 338 with an Allison 3000 series transmission with a driveline mounted split shaft PTO installed. Upon activation of the OEM installed controls the transmission will need to operate 4th gear lockup with max RPM of 1100 RPM. 12 volts is applied to the PTO switch #1 ECM interface when activated. The resume switch can now be utilized to increase the RPM's and the set switch can be used to decrease the RPM's.

Configuration and RPM Control: Utilizing the Hino DX software, access the customization tab for the ECM and make the changes to the parameters as outlined immediately below. Reference tables one and two at the end of this document for DX parameter information.

<u>Parameter</u>	<u>Original Value</u>	<u>New Value</u>
224	0	1
231	0	1
233	0	1
264	0	100
293	0	1100

Utilizing Allison DOC software, any relevant customer modifiable constants will need to be changed. In this example GPIO package to 216 was selected to enable the lockup feature. Additionally, pins had to be added to the transmission control module and wired to the vehicle. In this example, the wiring was the same as what is outlined in the AJ1 package outlined in **Figure 2**.

See figure two below for more information on Pump Mode (4th Lockup) Input for more specific information making connections to the TCM and the function of the interface. **It is important to note, there are a number of these configurations often times for each input/output function as well as other important interface and safety information contained in each document. This information should be verified against the live document from Allison Transmission for the specific application at the time of review and installation.** Figure 2 on the following page is just one example that may or may not work for the application.



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Figure 2

PUMP MODE (4TH LOCKUP) INPUT – OPERATOR AND PUMP ACTIVATED INPUT AJ1: WIRES 122 & 123 / OUTPUT C: WIRE 145

APPLICABLE TRANSMISSIONS: 3000 Product Family, 4000 Product Family

DESCRIPTION: This function is enabled when wire 123 is switched to send power to the TCM, and a switch is closed to complete the circuit between input wire 122 and ground. The TCM will command the transmission to operate in direct drive (1:1) lockup when:

- Function is enabled
- Vehicle park brake is activated
- Pump Mode is selected
- Auxiliary equipment is fully engaged
- Drive is selected on the shift selector

NOTE: If a butt-tooth condition hinders full engagement of the pump when the switch on wire 123 is closed, the TCM will command limited rotation of the output shaft in order to promote pump engagement. This ceases when the TCM detects pump engagement on wire 122. This is repeated when the pump is disengaged until a range shift is commanded, or after 30 seconds, whichever occurs first.

The switch on wire 123 reflects the selection of Pump Mode by the operator and the application of the park brake. The separate switch on wire 122 indicates that the split-shaft PTO is fully engaged physically, and illuminates the OK To Pump lamp. When either of the input signals is disabled, normal automatic shifting resumes.

USES: This function is used in commercial vehicles, but **not fire trucks or other emergency vehicles.** Typical vehicle configuration has a split-shaft PTO to drive a pump, fan or other auxiliary equipment. Activation of this feature initiates the engagement of the split-shaft PTO and shifts the transmission to direct drive lockup.

CUSTOMER MODIFIABLE CONSTANTS:	Required Value	Default Value	Allowable Range	Units
• Range Indicator, 6-Speed Models	4th Gear	Neutral	R,N,6,5,4,3,2,1	range
• Range Indicator, 4000 7-Speed Models	5th Gear	Neutral	R,N,7,6,5,4,3,2,1	range

VOCATIONS: Sewer Cleaners

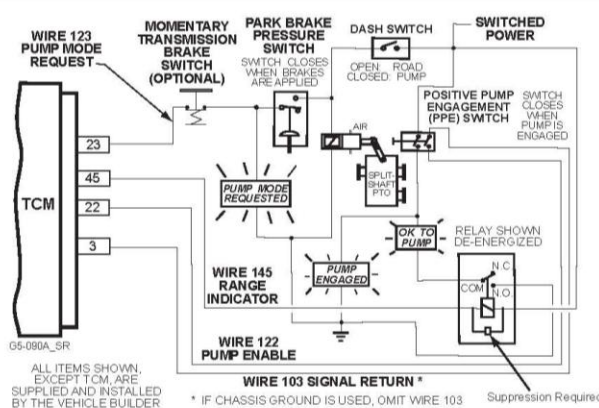
FUNCTION RESPONSE TO TCM POWER INTERRUPTION (power-off, followed by power restored):

Power off: Lockup clutch off. Transmission remains in 1:1 gear.

Power restored: Lockup clutch off. Transmission remains in 1:1 gear.

WARNING: If this function is enabled in the shift calibration, the function **MUST** be integrated into the vehicle wiring. Refer to this function's cover sheet.

NOTE: The Range Indicator default is Neutral. For installations utilizing Pump Mode (4th Lockup), RANGE INDICATOR MUST BE CHANGED TO 4TH GEAR FOR 6-SPEED MODELS, 5TH GEAR FOR 4000 7-SPEED MODELS, when the TCM calibration is defined or with Allison DOC®.



SYSTEM OPERATION

OPERATOR ACTION - System Response

TO ENGAGE:

1. SELECT NEUTRAL USING THE SHIFT SELECTOR: Transmission shifts to Neutral.
2. APPLY PARK BRAKE: None
3. SELECT PUMP WITH DASH SWITCH: Turns on Pump Mode Requested light. Turns on input signal to TCM (wire 123) which requests pump mode. When split-shaft shifts, wire 122 is activated and the Pump Engaged light is turned on.
4. SELECT DRIVE: Transmission shifts to 1:1 lockup. OK To Pump light is turned on.

TO DISENGAGE:

1. SELECT NEUTRAL USING THE SHIFT SELECTOR: Transmission shifts to Neutral if output shaft speed is less than 1000 rpm.
2. SELECT ROAD MODE: PTO disengages. If output shaft rotation continues, press the Momentary Trans. Brake switch before selecting Road Mode. This will cause the transmission output shaft to stop if the transmission is in Neutral and output shaft speed is less than 175 rpm.

WARNING! This schematic shows the intended use of the specified controls feature which has been validated in the configuration shown. Any miswiring or use of this feature which differs from that shown could result in damage to equipment or property, serious personal injury, or death. **Allison Transmission is not liable for consequences associated with miswiring or unintended use of this feature.**



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Table 1 – DX Parameters

DX Number	DX Description	Operational Description	
279	PTO Engine Speed Setting	PTO Set Engine Speed Setting	0-1800 RPM
263	Preset Engine Speed Rate of Increase	When a preset parameters is used this can influence the ramp rate. The scale is from 1-100 with 1 being the slower ramp rate and 100 being the faster ramp rate.	Percentage
293	PTO Accelerator Maximum Engine Speed Setting	When PTO switch is activated the accelerator and Hino hand throttle are both impacted. With PTO switch off only the hand throttle is impacted 100% of the time.	RPM
294	Engine Speed Conditions to Enable Accelerator Control	Allows for PTO operation only when the engine speed is lower than the preset speed.	RPM
295	Engine Speed Conditions to Cancel Accelerator Control	When the RPM gets to the set value, the RPM control is cancelled and the engine returns to idle.	RPM
268	Vehicle Speed Conditions to Enable PTO Accelerator Control	This parameter only functions with the Hino Hand throttle. PTO operation is not allowed unless the vehicle speed is at or below the speed set by this customization. When PTO operation is to be allowed when the vehicle is stopped completely set a value greater than "0". When "0" is entered, PTO operation may require additional time. If the PTO is mounted via split shaft gear case, the vehicle speed is detected at the time of PTO operation. This setting value should be lower than value in vehicle speed conditions to cancel the PTO accelerator control.	MPH
269	Vehicle Speed Conditions to Cancel PTO Accelerator Control	This parameter only functions with the Hino hand throttle.	MPH



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Table 1 – DX Parameters

DX Number	DX Description	Operational Description	
269	Vehicle Speed Conditions to Cancel PTO Accelerator Control	This parameter only functions with the Hino hand throttle. The PTO is cancelled when the vehicle speed exceeds the speed set by this customization. If the vehicle moves slightly, set “vehicle speed conditions to enable PTO accelerator control” in the customization menu to a comparatively small value and set a slightly higher value for this customization. If the PTO is mounted via split shaft gear case, the vehicle speed is detected at the time of PTO operation. This setting value should be higher than the value in “vehicle speed conditions to enable PTO accelerator control”.	MPH
285	Cruise Control Switch PTO Maximum Engine Speed		RPM
267	Cruise Control Switch PTO Engine Speed Rate of Increase	Cruise switch ramp rate each time the switch is depressed	RPM
286	Preset PTO #1 Engine Speed Set	Preset engine RPM	RPM
287	Preset PTO #2 Engine Speed Set	<p>Preset engine RPM</p> <p>Engine ECU can incorrectly detect diagnostic code P073D (incorrect info from the TCM) during Allison Transmission lock-up control. If the PTO lock-up signal goes to the TCM, only the PTO idle-up signal goes to the engine ECU. From the 15MY unit, this problem can be resolved by the following procedure:</p> <ol style="list-style-type: none"> 1. “Preset PTO Flag” should be set at 0. 2. “PTO set engine speed” should be set at 750 RPM. 3. “PTO lock-up signal” should be sent to TCM. 	RPM



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Table 2 – Interlock DX Parameters

DX Number	DX Description	Operational Description	
212	PTO Accelerator Inhibit Safety Control Flag	Hino remote hand throttle on/off	0=OFF 1=ON
224	PTO Operation Accelerator Pedal Disable Flag	RPM control by the accelerator pedal when PTO is on	0=OFF 1=ON
225	PTO Operation Inhibit Safety Control Flag	Hino remote hand throttle on/off regardless of PTO switch activation	0=OFF 1=ON
226	PTO Operation Idle Knob Disable Flag	Hino remote hand throttle is disabled	0=OFF 1=ON
227	Automatic Engine Idling Speed Increase Disable During PTO Operation Flag	Automatic idle speed increasing for engine warm up/air compressor during PTO operation becomes enabled	0=OFF 1=ON
232	PTO Speed Control Operation Parking Brake Interlock Safety Control Flag	PTO RPM change is only allowed when park brake is engaged if parameter is changed to 1	0=OFF 1=ON
233	PTO Speed Control Operation Neutral Status Interlock Safety Control Flag	RPM control when the vehicle is not in neutral	0=OFF 1=ON
357	Engine Stop Switch During PTO Operation Flag	Initial setting is that engine stop switch does NOT work during PTO operation when the vehicle is moving at 30km/h (18.7 MPH) or more.	0=OFF 1=ON
234	PTO Speed Control Operation Enable with Application of Brake Pedal Flag	The brake pedal will need to be depressed prior to PTO activation. Once this is completed once it does not need to occur again until the key is cycled.	0=OFF 1=ON
235	PTO Speed Control Operation Disable with Application of Brake Pedal Flag	The brake pedal will interrupt TPO engine RPM control when depressed	0=OFF 1=ON



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Table 2 – Interlock DX Parameters

DX Number	DX Description	Operational Description	
236	PTO Speed Control Operation Enable with Application of Clutch Pedal Flag	PTO operation activated when PTO switch is turned ON and the clutch pedal is applied.	0=OFF 1=ON
237	PTO Speed Control Operation Disable with Application of Clutch Pedal Flag	PTO operation can be cancelled when the clutch pedal is applied.	0=OFF 1=ON
231	Preset PTO Flag	Allows for preset parameter to operate when changed from 0-1.	0=OFF 1=ON
229	Cruise Control Switch Inhibit During PTO Operation Flag	Set/resume switch = decrease/ increase RPM. This setting does NOT work when Pre-Set PTO flag is activated. This setting does not work in the following conditions. (1) Cruise main switch is NOT turned ON (08MY or before), (2) Vehicle speed is NOT "0", (3) Gear position is NOT neutral, (4) Service brake is applied, (5) Clutch pedal is applied. From the 15MY unit, engine speed control is possible by cruise control even if the vehicle speed is NOT "0" during PTO operation.	0=OFF 1=ON



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FAQ's

Q: I've installed a PTO on an Allison transmission and do not have Allison DOC software to change the customer modifiable constants. Will the PTO operate correctly?

A: This is an answer that the final stage manufacturer and/or up fitter will have to answer this question. Hino Motor Sales U.S.A. Inc advises whenever an interface is made with Hino vehicles that safety is a top priority.

Q: We are working on changing a customer from one brand to Hino and would like to discuss power take off's with someone from Hino, who should we contact?

A: Contact James Utz from Hino Motor Sales. The contact information is immediately below.

James Utz

Application Support Specialist, Product Planning

Product Planning Operations

Hino Motors Sales U.S.A.,Inc.

A Toyota Group Company

41180 Bridge Street

Novi, MI 48375

utz@hino.com

Phone 248-699-9389

Q: I read through this document and did not see the answer I was looking for. Can I just call and get the answer instead of looking at the suggested supporting material or contacting the OEM/up fitter?

A: Please read and understand referenced supporting material then contact Hino Application Support.

Q: We are transferring a body from brand "x" company with a PTO interface. We transplanted all of the parts, but it is not working properly. What should I do next?

A: Chassis may require PTO parameter changes in order for PTO to operate.



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