

16.0 Dedicated PTO Operation

Engine PTO operation requires some or all of the following OEM installed switches: PTO ON/OFF, PTO Set/Resume, PTO Engine RPM Set Speed A and/or B, Cruise Control Set/Resume, Service Brake Pedal Position #1, Service Brake Pedal Position #2, Transmission Neutral, and Clutch Pedal Position.

PTO operation, depending on the application, can use many switch inputs, lamp outputs, or outputs from the ECM to drive solenoids. These inputs/outputs are programmable across several ECM terminals to provide greater flexibility to the OEM and the Body Builder when designing a particular chassis. The wiring diagrams located throughout this chapter outline typical or commonly used ECM terminals and circuit configurations. Individual OEMs or Body Builders may use different ECM terminals or circuits for a particular application depending on their needs.

There are five programmable PTO Configurations available:

1. Off
2. Cab Switches
3. Remote Switches
4. Remote Throttle
5. Remote Throttle & J1939 Speed Control

PTO may be configured to allow for operation from the cab using cruise control switches and foot throttle. PTO may be configured to operate away from the cab at a remote location using a throttle, switches or both. Programmable limits are available for engine speed, vehicle speed and cab throttle input. Other programmable features include engine rpm ramp rates and multiple elevated speeds. All of these configurations allow the OEM/Body Builder to configure switch inputs and features to meet PTO application needs including:

Bulk Hauler, Fire Truck, Cement Mixer, Refuse Packer, Crane, Bucket Truck, etc.

Caterpillar requires all switches, and all components used in these circuits to meet the specifications as outlined in this document. Caterpillar recommends the OEM provide a customer access connector in an easily accessible location to aid in installation of these features.

16.1 Advantages of PTO Configurations

- 1) Reduces or eliminates the amount of alterations to the cab wiring.
- 2) Unnecessary to ground accelerator pedal position sensor to disable cab accelerator pedal.
- 3) Provides an optional torque limit for temporary protection of equipment.
- 4) Provides an optional PTO Top Engine Limit to allow maximum use of engine speed to protect speed sensitive equipment.
- 5) Provides optional PTO set speeds for those applications where preset speeds above low idle are required.
- 6) Whenever the PTO On/Off circuit is ON the Engine Brake is disabled.
- 7) Disabling of the Idle Shutdown Timer when the PTO On/Off circuit is ON.
- 8) Cooling fan can be programmed to turn On and remain On while the PTO On/Off switch is ON.

16.2 PTO Inputs

PTO can be programmed to accept input from the Cruise Control switches, PTO Remote Set and Resume switches, Remote Throttle, J1939 TSC 1 speed commands, and up to two set speed switches. Adding these inputs will allow the aftermarket body-builder to add necessary components without altering the cab cruise control switch wiring.

16.3 Input Electrical Specifications

Electrical specifications for Switch Inputs are located in Chapter 13. Electrical specifications for the remote accelerator pedal position sensor are located in Chapter 7.

16.4 Sensor Common for PTO Applications

ECM Vehicle Harness Connector J1/P1 terminal-3 (Input Sensor Common #2) is designated as the Sensor Common connection for PTO additions. Caterpillar requires this connection be reserved for components connected to the engine to control engine speed for PTO applications only. It should only be used when PTO wiring is or will be required on the vehicle. The PTO Components can also use J1/P1 terminal-5 (AP Sensor/Switch Sensor Common) or Terminal-18 (Input Sensor Common #1) as a common connection if required. Devices not interfacing to the ECM for use with the Inputs must not be connected to Input Sensor Commons.

All switches connected to the Input Sensor Commons must also meet the specifications indicated in Chapter 4 of this document.

16.5 PTO Parameter and Switch Function

This section describes the functions, inputs and programmable limits for PTO.

16.5.1 PTO On/Off Switch

This switch enables PTO features and functions.

16.5.2 PTO Set Speed

This is not a parameter but the speed to which the engine will be controlled until changed by an operator input. The PTO Set Speed value may be viewed using the Electronic Technician service tool.

16.5.3 Cruise Control Set/Resume Switch

When PTO Configuration is programmed to Cab Switches, these switches can be used to control engine speed. These switches can raise and lower engine speed according to the "Cruise/Idle/PTO Switch Configuration" parameter setting. Toggling the Set Switch will establish the current engine rpm as the "PTO Set Speed".

Once the PTO Set Speed has been established, pressing and holding the "Set" switch will cause the engine to accelerate, if programmed to "Set/Accel", at the programmed Idle/PTO Ramp Rate.

Once the PTO Set Speed has been established, toggling the "Set" switch will bump the engine rpm UP, if programmed to "Set/Accel", at the programmed Idle/PTO Bump RPM.

Once the PTO Set Speed has been reached, pressing and holding the "Resume" switch will cause the engine to decelerate, if programmed to "Resume/Decel", at the programmed Idle/PTO Ramp Rate.

Once the PTO Set Speed has been established, toggling the "Resume" switch will bump the engine rpm DOWN, if programmed to "Resume/Decel", at the programmed Idle/PTO Bump RPM.

If the PTO Engine RPM Set Speed parameter is programmed, toggling the "Set" switch will cause the engine to ramp up from the current engine rpm to the programmed PTO Engine RPM Set Speed setting. If this switch is toggled while the engine is at the PTO Engine RPM Set Speed rpm, the engine will ramp to the PTO top engine limit.

If the PTO Engine RPM Set Speed parameter is programmed, toggling the "Resume" switch will cause the engine to ramp Down from the current engine rpm to the programmed PTO Engine RPM Set Speed setting or Low Idle if the engine is at the PTO To Set Speed rpm.

These switches disregard the "Cruise/Idle/PTO Switch Configuration" parameter if the "PTO Engine Set Speed" and the "PTO To Set Speed" parameters have been programmed.

16.5.4 PTO Switch On Lamp

The ECM can be used to connect a PTO Switch On Lamp. The PTO Switch On Lamp can be configured to either High Side (2 Amp) or Low Side (Sensor Common) terminals on the ECM. See the table below for a list of valid ECM terminals. If the output is unavailable, a double pole/double throw PTO On/Off Switch can be used to connect a PTO Switch ON Lamp between +Battery and Ground. If a Remote PTO configuration is used, a lamp should be installed in the cab and at the remote operations station. If the engine is outside the programmed parameters for PTO Mode when the PTO On/Off switch is turned ON, The PTO on Lamp will flash until the engine is within programmed parameters. The Lamp will stay on steady until PTO mode is terminated.

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NOTE: It is the OEM/Body Builders responsibility to properly wire and/or fuse the circuit. Failure to do so could result in damage to the chassis or one of its components.

Parameter	Default	Programmable ECM Terminal Assignments
PTO Switch On Lamp	None	High Side Drivers: (2 Amp) J1: 10, 11, 12, 13, 19, 20
		Low Side Drivers: (Sensor Common) J1: 29, 30, 31

16.5.5 PTO On/Off Switch

This parameter designates where the PTO On/Off switch will connected to the ECM. Choices include a hardwired switch and a J1939 data link based switch message.

The PTO On/Off Switch can be configured to one of several available hardwired ECM terminals and a J1939 data link based switch message.

Parameter	Default	Programmable ECM Terminal Assignments
PTO On/Off Switch	None	J1/P1: 6, 7, 22, 23, 35, 40, 44, 45, 46, 47, 56, 58, 59, 60, J1939 Body Controller, J1939 Cab Controller, J1939 Instrument Cluster, J1939 Cab Display

16.5.6 Remote PTO Set Switch

When the PTO Configuration has been programmed to Remote Switches, Remote Throttle, or Remote Throttle & J1939 Speed Command, this switch functions like the Cruise Control Set Switch. Choices include a hardwired switch and a J1939 data link based switch message.

The Remote PTO Set Switch can be configured to one of several available hardwired ECM terminals and a J1939 data link based switch message.

Parameter	Default	Programmable ECM Terminal Assignments
Remote PTO Switch	None	J1/P1: 6, 7, 22, 23, 35, 40, 44, 45, 46, 47, 56, 58, 59, 60, J1939 Body Controller, J1939 Cab Controller, J1939 Instrument Cluster, J1939 Cab Display

16.5.7 Remote PTO Resume Switch

When the PTO Configuration has been programmed to Remote Switches, Remote Throttle, or Remote Throttle & J1939 Speed Command, this switch functions like the Cruise Control Resume Switch. Choices include a hardwired switch and a J1939 data link based switch message.

The Remote PTO Resume Switch can be configured to one of several available hardwired ECM terminals and a J1939 data link based switch message.

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Parameter	Default	Programmable ECM Terminal Assignments
Remote PTO Resume Switch	None	J1/P1: 6, 7, 22, 23, 35, 40, 44, 45, 46, 47, 56, 58, 59, 60, J1939 Body Controller, J1939 Cab Controller, J1939 Instrument Cluster, J1939 Cab Display

16.5.8 PTO Top Engine Limit

This parameter may be used to limit the maximum engine RPM while in PTO mode.

16.5.9 PTO Engine RPM Set Speed

This parameter is for selecting a specific engine rpm for use while in PTO mode. Depending on programming, the engine will go to this rpm when PTO is enabled or by toggling a Cruise Control or Remote PTO “Set” switch after PTO is enabled. This rpm setting may be overridden by throttle or Set Speed A and B switch inputs; according to programmed limits.

16.5.10 PTO to Set Speed

Programming this parameter to “Yes” causes the engine to go to the PTO Engine Set Speed rpm when the PTO switch is turned On. Programming this parameter to No will cause the engine to remain at the Low Idle rpm until another input, switch or throttle, is actuated.

16.5.11 PTO Engine RPM Set Speed A

This parameter setting may be programmed for a specific engine speed while in PTO mode. This rpm setting is enabled with the “PTO Engine RPM Set Speed Input A” switch closure. This speed will override hardwired cab throttle, hardwired remote throttle, set speed B, and set/resume settings. PTO Engine RPM Set Speed A can only be overridden by J1939 TSC 1 speed commands.

16.5.12 PTO Engine RPM Set Speed Input A

This parameter is used to enable the switch input to activate PTO Engine RPM Set Speed A. Choices include hardwired switches and J1939 data link based switch messages.

The PTO Engine RPM Set Speed A Switch can be configured to one of several available hardwired ECM terminals and J1939 data link based switch messages.

Parameter	Default	Programmable ECM Terminal Assignments
PTO Engine RPM Set Speed Input A	None	J1/P1: 6, 7, 22, 23, 35, 40, 44, 45, 46, 47, 56, 58, 59, 60, J1939 Body Controller, J1939 Cab Controller, J1939 Instrument Cluster, J1939 Cab Display

16.5.13 PTO Engine RPM Set Speed B

This parameter setting may be programmed for a specific engine speed while in PTO mode. This rpm setting is enabled with the “PTO Engine RPM Set Speed Input B” switch closure. This speed will override throttle and set/resume settings. PTO Engine RPM Set Speed A or J1939 TSC 1 speed commands can override PTO Engine RPM Set Speed B.

16.5.14 PTO Engine RPM Set Speed Input B

This parameter is used to enable the switch input to activate PTO Engine RPM Set Speed B.

The PTO Engine RPM Set Speed Input B can be configured to one of several available hardwired ECM terminals.

Parameter	Default	Programmable ECM Terminal Assignments
PTO Engine RPM Set Speed Input B	None	J1/P1: 6, 7, 22, 23, 35, 40, 44, 45, 46, 47, 56, 58, 59, 60

16.5.15 Maximum PTO Enable Speed

The engine rpm setting may be programmed to the maximum engine rpm speed for PTO to be enabled. PTO will not engage if the engine is above this setting. This protects equipment that requires low rpm engagement. PTO will not be active until the engine drops below this limit.

16.5.16 PTO Cab Controls RPM Limit

This parameter may be programmed to limit the maximum engine rpm controlled by the cab throttle and cruise switches during PTO. This parameter does not control hardwired remote throttle or speed commands received over the J1939 data link TSC 1 message.

16.5.17 PTO Kickout Vehicle Speed Limit

This parameter may be programmed to set a vehicle speed limit that PTO functions and controls will operate. Exceeding this vehicle speed limit will cause PTO to “kick out” which will return the engine to Low Idle, return engine speed control to the cab throttle and cause the PTO active output to turn Off.

16.5.18 Torque Limit

This parameter may be programmed to limit the engine’s maximum torque output. This feature is not available until the PTO Configuration is programmed to a value other than OFF. The Torque Limit Switch input parameter must be programmed and a switch installed to enable this function. Torque Limit may be used without PTO being active.

16.5.19 Torque Limit Switch

The Torque Limit Switch Input may not be programmed until the PTO Configuration has been programmed to other than off. Once the PTO Configuration has been programmed to other than off, the ECM will respond to the Torque Limit Switch if the PTO switch is On or Off. The ECM will ignore the Torque Limit Switch if PTO Configuration is programmed to Off.

The Torque Limit Switch can be configured to one of several available hardwired ECM terminals.

Parameter	Default	Programmable ECM Terminal Assignments
PTO Torque Limit Switch	None	J1/P1: 6, 7, 22, 23, 35, 40, 44, 45, 46, 47, 56, 58, 59, 60

16.5.20 PTO Shut Down Time

This parameter setting is used to set the amount of time, in minutes, the engine will run while in PTO mode. The engine will shut down when this timer counts down to zero. The timer will only count with no vehicle speed and the PTO On/Off circuit ON. This parameter is disabled if programmed to 0 (default).

NOTE: This feature does not shut down vehicle power. The ECM and vehicle remain powered.

16.5.21 PTO Shut Down Timer Maximum RPM

When the engine drops below this rpm the PTO Shut Down Timer will begin to count. This timer will be reset to “zero” if the engine rpm is raised above this setting.

16.5.22 PTO Low Idle Percent Load Threshold

This parameter is used to determine when the PTO Idle Shutdown Timer will function based on engine load factor. When engine load is greater than the programmed threshold value the PTO Idle Shutdown Timer is temporarily disabled.

The PTO Idle Shutdown Timer will resume operation once the engine load is below the programmed value.

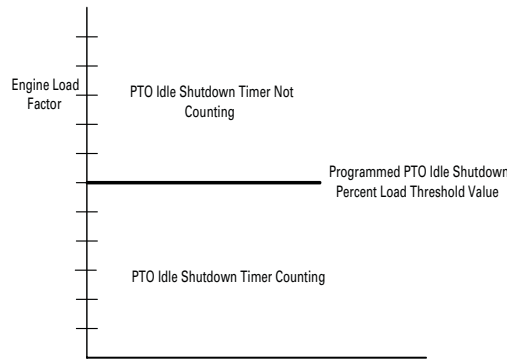


Figure 50 – PTO Idle Shutdown Percent Load Threshold Graph

Parameter	Default	Programmable Range
PTO Idle Shutdown Percent Load Threshold	100%	0 – 100 %

16.5.23 PTO Activates Cooling Fan

Programming this parameter to “Continuous” turns the engine controlled fan “On” while in PTO mode. The fan will remain “On” while the engine is in PTO mode. The fan will resume normal operation if PTO is disabled. This feature will not function unless the fan is controlled by the engine ECM.

16.5.24 Ignore brake/clutch/neutral/park/Neutral/Park Switch

The Ignore Brake/Clutch/Neutral/Park switch input is used to prevent the brake, clutch, neutral, or park brake switches from causing PTO to kick out. This switch input is for the PTO Cab Switches configuration. Remote Switches and Remote Throttle configurations do not respond to the brake and clutch switches. This switch can also be used to prevent the brake, clutch, neutral, and park brake switches from causing Extended Idle to kick out.

The Ignore brake/clutch/neutral/park/Neutral/Park Switch can be configured to one of several available hardwired ECM terminal.

Parameter	Default	Programmable ECM Terminal Assignments
Ignore brake/clutch/neutral/park/Neutral/Park Switch	None	J1/P1: 6, 7, 22, 23, 35, 40, 44, 45, 46, 47, 56, 58, 59, 60

16.5.25 PTO Active Output

The PTO Active Output parameter is available for controlling an output when the engine is in PTO Mode. This output will turn “On” when the PTO Switch is turned “On”, and all conditions are met for PTO operation. This output will turn OFF when the engine has “kicked out” of PTO mode or the PTO ON/OFF switch has been turned OFF. The PTO Active Output is available as a High Side (2 Amp) or Low Side (Sensor Common) driver. The table below outlines what ECM terminals are available.

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Parameter	Default	Programmable ECM Terminal Assignments
PTO Active Output	None	High Side Driver: J1: 10, 11, 12, 13, 19, 20
		Low Side Driver: J1: 29, 30, 31

NOTE: The wiring diagram below shows the PTO Active Output wired as a high side driver from the ECM.

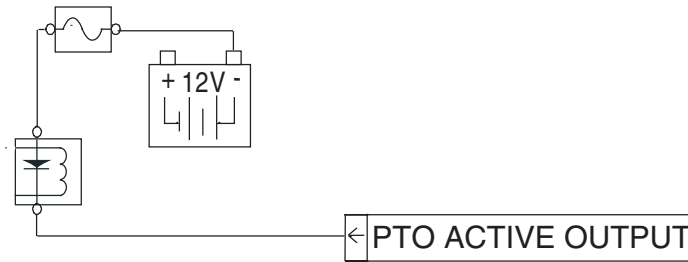


Figure 51 – PTO Active Output Wired as High Side Driver from ECM.

NOTE: The wiring diagram below shows the PTO Active Output wired as a low side driver from the ECM.

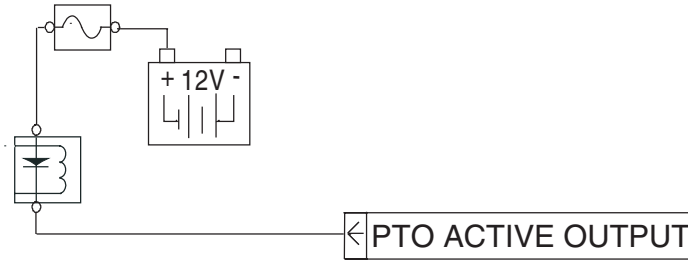


Figure 52 – PTO Active Output Wired as a Low Side Driver from the ECM.

16.6 PTO Interlocks

The switches labeled as PTO Interlock in the wiring diagrams are redundant switches that can be added to insure the engine is put in PTO mode only when the vehicle is ready and prepared for PTO operation. These switches may include a parking brake switch, transmission neutral switch or other interlocks that are required for the application.

16.7 PTO Customer Access Connector

Caterpillar recommends the OEM provide a customer access connector for those chassis' frequently used in vocational applications. This connector should provide wiring from the ECM to a connector easily located and identified on the vehicle. Caterpillar recommends the circuits listed in the following table be provided at this connector.

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The table below shows all ECM switch inputs and ECM outputs that can be used. ECM Terminal assignments are programming dependent.

Terminal Description	ECM Terminal Assignment	Parameter
Switch Input	J1: 6, 7, 22, 35, 40, 44, 45, 46, 47, 56, 58, 59, 60	PTO On/Off Switch
		Remote PTO Set Switch
		Remote PTO Resume Switch
Input #8	Terminal 68	Remote Throttle
Sensor Common	Terminal 5	Remote Throttle Common
Input sensor common #2	Terminal 3	N/A
High Side Outputs (2 Amp)	J1: 10, 11, 12, 13, 19, 20	PTO Switch On Lamp PTO Active Output
Low Side Outputs (GND)	J1: 29, 30, 31	
Additional Recommended Connections (Must be separate from ECM wiring)		
+ Battery (Switched)	N/A	Remote Throttle Power
- Battery	N/A	Remote Throttle Sensor Common

NOTE: Other inputs such as PTO Engine RPM Set Speed Input A, PTO Engine RPM Set Speed Input B, and the J1939 Data Link for TSC 1 speed commands, can also be added if desired.

16.8 PTO Configurations

The table below outlines the operating differences for each of the PTO Configurations. The table shows each inputs affect on the engine rpm when the PTO On/Off switch is ON for each configuration. For the following table, an “L” means the input can return the engine to low idle from a set speed, a “A” means the input can adjust engine rpm, and “P” means the input function is programmable to a limit.

PTO Configuration	Cruise On/Off	Cruise Set	Cruise Resume	Cruise Pause	Cab Accelerator	Remote Throttle	Service Brake	Clutch	Neutral	PTO Set	PTO Resume	PTO Engine RPM Set Speed Input A	PTO Engine RPM Set Speed Input B
Off		A	A	L	A		L	L	L				
Cab Switches	L	A	A	L	AP		L	L	L			A	A
Remote Switches										A	A	A	A
Remote Throttle						AP				A	A	A	A
Remote Throttle and J1939 Speed Command						AP				A	A	A	A

16.8.1 PTO Configuration – Cab Switches, Remote Switches, Remote Throttle, or Remote Throttle & J1939 Speed Command Operation

When the PTO On/Off switch is turned to the ON position and vehicle speed and engine RPM are within programmed limits:

1. A PTO Switch On Lamp comes on (if programmed).
2. The PTO Top Engine Limit is Activated.
3. The engine will proceed directly to the PTO Engine RPM Set Speed if programmed.

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4. The engine will proceed directly to the PTO Engine RPM Set Speed A if switch A is ON and a valid RPM is programmed.
5. The engine will proceed directly to PTO Engine RPM Set Speed B if switch B is ON, PTO Engine RPM Set Speed A switch is OFF, and a valid RPM is programmed.
6. The Engine Retarder is disabled.
7. The PTO Active Output is activated (if programmed).

16.8.2 PTO Configuration – Cab Switches Operation Differences

1. The cruise control Set/Resume switch and cab throttle can be used to adjust engine speed.
2. Optional Set Speed A and/or B switch inputs are available to adjust engine speed.
3. The Cruise Control Pause Switch (if equipped) will cause PTO to kick out if turned ON.
4. The cab throttle can be limited to Low Idle, Top Engine Limit, or the PTO Top Engine Limit.
5. Brake and Clutch switch inputs can cause PTO to kick out.
6. Ignore brake/clutch/neutral/park/Neutral/Park switch input available for allowing mobile operation of vehicle.

16.8.3 PTO Configuration – Remote Switches Operation Differences

1. The remote PTO Set/Resume (not the Cruise Control Set/Resume switch) switch can be used to adjust engine speed.
2. Optional Set Speed A and/or B switch inputs are available to adjust engine speed.
3. The cab throttle, cab cruise control, brake, clutch and neutral switches are ignored.
4. The PTO Active Output is activated (if programmed).

16.8.4 PTO Configuration – Remote Throttle Operation Differences

1. The remote throttle input is available to adjust engine speed.
2. Remote PTO Set/Resume switch inputs may be used to adjust engine speed.
3. Optional PTO Engine RPM Set Speed A and B inputs are available to adjust engine speed.
4. The cab throttle, cab cruise control, brake, clutch and neutral switches are ignored.

16.8.5 One Speed Above Low Idle with PTO Switched On

Program the PTO Top Engine Limit and the PTO Engine RPM Set Speed to the same value. Program the PTO to Set Speed parameter to Yes. The ECM will ramp up to the pre-programmed PTO Engine RPM Set Speed when the PTO On/Off switch is turned ON. When the PTO Top Engine Limit is set to the same value as the PTO Engine RPM Set Speed, the engine will not exceed this rpm.

The Service Brake Pedal Position, and Clutch Pedal Position circuits are included because they will interrupt a set engine rpm. The cab accelerator pedal position sensor can be limited to low idle, PTO Top Engine Limit, or Top Engine Limit using the PTO Cab Throttle RPM Limit parameter. The Cab Throttle will have no affect on engine RPM.

16.8.6 PTO Configuration – Remote Throttle & J1939 Speed Command

1. TSC 1 Speed Commands available to adjust engine speed.
2. The remote throttle input is available to adjust engine speed.
3. Remote PTO Set/Resume switch inputs may be used to adjust engine speed.
4. Optional PTO Engine RPM Set Speed A and B inputs are available to adjust engine speed.
5. The cab throttle, cab cruise control, brake, clutch and neutral switches are ignored.

Parameter settings for PTO Configuration Cab Switches with One Speed Above Idle Circuit

Customer Parameter	PTO Configuration	PTO Cab Throttle RPM Limit	PTO TEL	PTO Engine RPM Set Speed	PTO to Set Speed
Parameter Setting	Cab Switches	Desired Limit	Desired RPM	Desired RPM	
Input/Output	Switch Input	Output	Cab Throttle		
Connection	PTO On/Off Circuit	PTO Switch On Lamp	J1/P1:66		

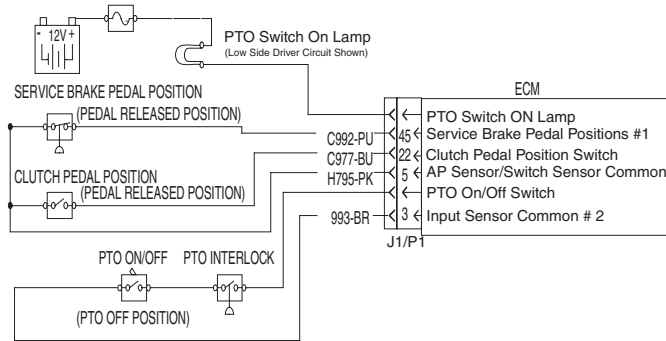


Figure 53 – PTO Configuration Cab Switches with One Speed Above Idle

16.8.7 One Speed Above Low Idle after PTO Switched On, Using Cruise Set/Resume

These diagrams provide cab accelerator pedal limiting before the rpm ramps up, and allows one speed above idle to be controlled from the Cruise Set/Resume switches. If the PTO to Set Speed parameter is programmed to NO, the ECM will not go to the programmed PTO Engine rpm Set Speed until the Set (rpm increase) switch is toggled. When the PTO Top Engine Limit is set to the same value as the PTO Engine rpm Set Speed, the engine will not exceed this rpm. Toggling the Set/Resume Switch in the Decel direction will cause the engine to ramp down from PTO Top Engine Limit to Low Idle. The Throttle can be used to control engine rpm if the engine is at Low Idle.

The Cruise Set/Resume, Service Brake, and Clutch circuits are included because they will interrupt a set rpm using the Cab Switches configuration. The cab accelerator pedal position sensor can be limited to low idle, PTO Top Engine Limit, or Top Engine Limit using the PTO Cab Throttle RPM Limit parameter.

NOTE: If the PTO Engine RPM Set Speed is programmed to 0 rpm, the Set/Resume switch can be used to bump (increment) engine speed up and down by the Idle/PTO Bump RPM parameter. Engine speed may be ramped as well according to the programmed value of the Idle/PTO Ramp Rate parameter.

Parameter settings for PTO Configuration Cab Switches with One Speed Above Idle Circuit

Customer Parameter	PTO Configuration	PTO Cab Throttle RPM Limit	PTO TEL	PTO Engine RPM Set Speed	PTO to Set Speed
Parameter Setting	Cab Switches	Desired Limit	Desired RPM	Desired RPM	No
Input/Output	Switch Input	Output	Cruise Set	Cruise Resume	
Connection	PTO On/Off Circuit	PTO Switch On Lamp	J1/P1:35	J1/P1:44	

NOTE: The wiring diagram below is a typical wiring diagram. Other ECM terminals may be used for various parameters that may function differently.

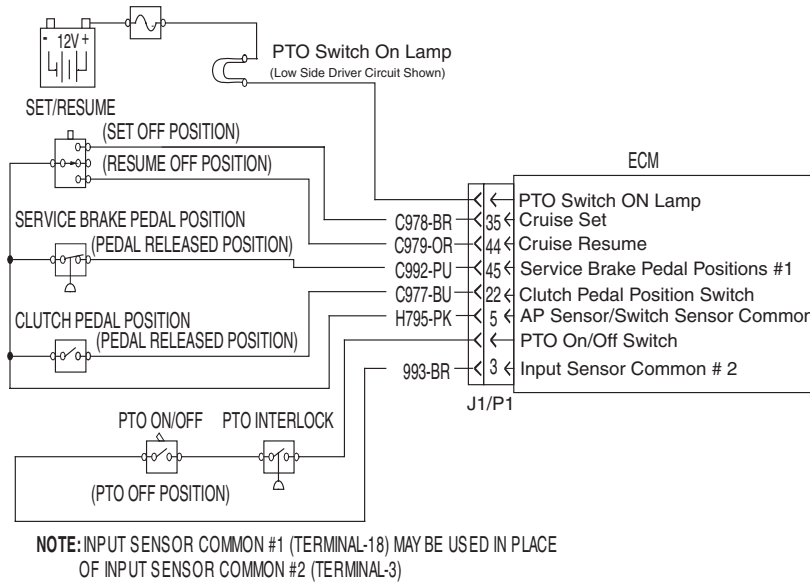


Figure 54 – PTO Configuration Cab Switches with One Speed Above Idle Circuit

16.8.8 PTO Configuration – Cab Switches with Torque Limiting

This configuration is identical to the configuration outlined above with the addition of a Torque Limit Switch. If a Torque Limit is programmed it ONLY applies when the Torque Limit Switch is in the ON position. This configuration requires the programming of the Torque Limit Switch to an ECM switch to ground input (default is None). Torque Limiting should only be used for temporary protection of equipment.

NOTE: The wiring diagram below is a typical wiring diagram. Other ECM terminals may be used for various parameters that may function differently.

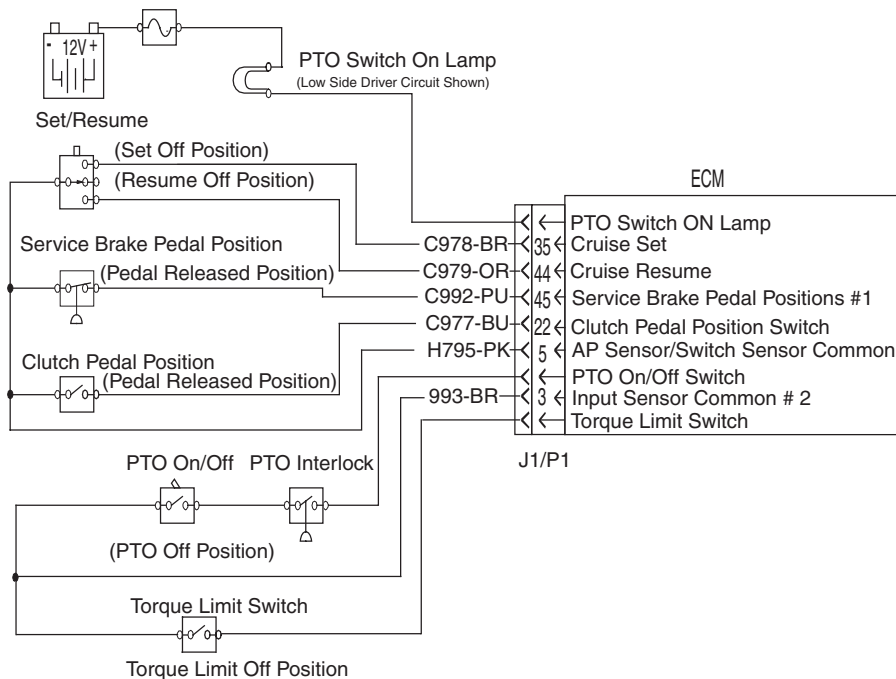


Figure 55 – Cab Switches with Torque Limiting

16.9 Cab Switches – with Ignore brake/clutch/neutral/park/Neutral/Park

This configuration is identical to the configuration outlined above with the addition of an Ignore Brake/Clutch Switch connected to an ECM switch to ground input. The Ignore brake/clutch/neutral/park/Neutral/Park Switch is intended for applications requiring mobile use of the vehicle with a set engine rpm that does **NOT** require the Brake or Clutch to disengage the engine rpm set speed. This is useful for applications such as a cement truck pouring curbs/roads, or a fire truck pumping water where vehicle speed is adjusted using the clutch or brakes but engine speed remains constant for proper pump operation. The programmable parameter Ignore brake/clutch/neutral/park/Neutral/Park Switch must be programmed to an ECM switch to ground input to enable this feature (Default is None).

NOTE: The wiring diagram below is a typical wiring diagram. Other ECM terminals may be used for various parameters that may function differently.

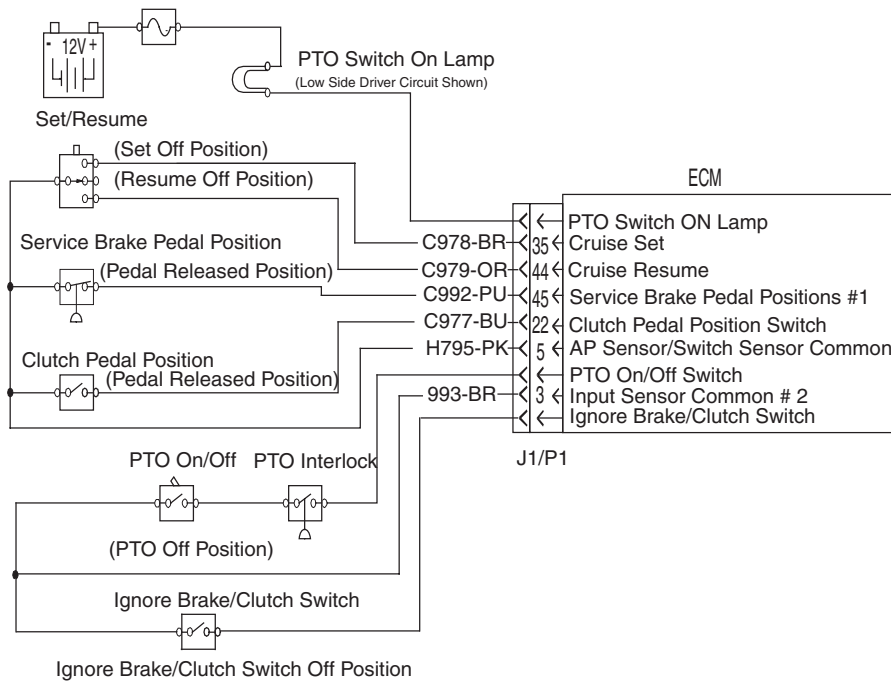


Figure 56 – Cab Switches with Ignore Brake/Clutch/Neutral/Park Switch

16.10 PTO Configuration – Cab Switches Programmable Options

The following list includes all of the programmable options available for the PTO Configuration Cab Switches:

- 1. Cruise/Idle/PTO Switch Configuration** – determines the function of the Set and Resume inputs when held in position or toggled. The two options are Set-Accel, Resume – Decel or Set-Decel, Resume-Accel. This applies to cruise control, idle, and PTO modes of operation.

NOTE: If the PTO Engine RPM Set Speed is programmed, the Set switch is always a RPM increase switch and Resume is always a RPM decrease switch for PTO.

- 2. Cruise Control Pause Switch Configuration** – If programmed to J1939 Body Controller, Instrument Cluster, Cab Controller, or Cab Display, this switch will act like the service brake or clutch switches for causing the PTO Mode to kick out. If in the ON position, this switch will prevent the engine from entering into PTO mode. There is no programmable parameter for ignoring this switch.
- 3. PTO Kickout Vehicle Speed Limit** – determines the vehicle speed operating range of the PTO inputs. If vehicle speed exceeds this limit the engine will either not allow a PTO engine speed to be set, or disengage a set PTO speed.
- 4. Idle/PTO RPM Ramp Rate** – determines the rate of engine speed acceleration/deceleration for the Resume, Accel, and Decel operation.

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5. **Idle/PTO Bump RPM** – determines the amount of rpm increase/decrease when the cruise Set/Resume switch is toggled in the Accel/Decel position. If a PTO Engine RPM Set Speed has been programmed this parameter does not apply.
6. **PTO Top Engine Limit** – Top RPM Limit of the engine while in PTO mode.
7. **PTO Engine RPM Set Speed** – program this parameter only if one or two specific engine speed points above low idle are desired. The parameter is bound by programmed low idle and PTO Top Engine Limit.
8. **PTO to Set Speed** – program this parameter to YES only if the application requires the engine speed to ramp up to the PTO Engine RPM Set Speed whenever the PTO On/Off circuit is turned ON.
9. **PTO Cab Throttle RPM Limit** – program this parameter if the operation requires limiting engine speed to protect equipment. If programmed to Low Idle, this parameter has the affect of ignoring/disabling the accelerator pedal position sensor when the PTO On/Off circuit is ON.
10. **Torque Limit** – program this parameter if a lower than rated torque limit is desired in order to temporarily protect equipment. The torque limit will apply whenever the Torque Limit switch is ON.
11. **PTO Engine RPM Set Speed A** – This parameter can be programmed to a desired set speed that can be attained by turning on a dedicated switch during PTO operation.
12. **PTO Engine RPM Set Speed Input A** – Use this parameter to select the Set Speed A switch input terminal.
13. **PTO Engine RPM Set Speed B** – This parameter can be programmed to a desired set speed that can be attained by turning on a dedicated switch during PTO operation.
14. **PTO Engine RPM Set Speed Input B** – Use this parameter to select the Set Speed B switch input terminal.
15. **PTO Shutdown Time** – This parameter is programmable between 3 to 1,440 minutes (a value of 0 turns off this feature). This parameter sets the duration of time (in minutes) that engine will operate, with the PTO On/Off circuit ON and no vehicle speed present, before shutting down.
16. **PTO Shutdown Timer Maximum RPM** – This parameter can be used to reset of the PTO Shutdown Timer if engine speed goes above the programmed PTO Shutdown Timer Maximum RPM. Programming this parameter to 2,640 rpm disables this feature.
17. **PTO Low Idle Percent Threshold** – This parameter enables/disables the PTO Shutdown Timer based on percent engine load during PTO operation.
18. **PTO Activates Cooling Fan** – This parameter determines if the engine cooling fan is on normally or Continuous while in PTO Mode. The Fan Control Type parameter must be programmed to other than None. One of the available switch input options and an additional switch installed for this feature to function.
19. **Ignore Brake/Clutch/Neutral/Park Switch** – This switch input allows PTO to disregard the status of the Service brake and Clutch switch settings.
20. **Torque Limit Switch** – Program this switch input to enable the programmed Torque Limit.
21. **PTO Active Output** – This output will turn “ON” when PTO is enabled and will remain active until PTO is turned Off or Kicked Out.
22. **Maximum PTO Enable Speed** – Maximum engine speed that PTO mode will engage. PTO mode will engage when engine rpm is at or below the programmed value.
23. **Maximum PTO Vehicle Speed** – Maximum speed allowed in pto mode. The engine ECM will limit fuel to maintain this vehicle speed.
24. **PTO Cab Controls RPM Limit** – Determines engine rpm limit of the Cab Accelerator Pedal Position Sensor when PTO Mode is Active. Programmable settings are Low Idle, TEL, or PTO TEL.

16.11 PTO Configuration – Remote Switches

The Remote Switches Configuration utilizes the PTO On/Off switch, Remote PTO Set and Resume switches and up to two Set Speed Switches. Each switch input may be hardwired directly to the ECM or switch input messages, except for the Set Speed B switch input, may be received over the J1939 Data Link. An optional pair of PTO Switch On Lamps (one in cab, the other out of the cab at the remote location – programming dependent) may be used.

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16.11.1 One Speed Above Low Idle with PTO Switched On

Program the PTO Top Engine Limit and the PTO Engine RPM Set Speed to the same value. Program the PTO to Set Speed parameter to Yes. The ECM will ramp up to the pre-programmed PTO Engine RPM Set Speed when the PTO On/Off switch is turned ON. When the PTO Top Engine Limit is set to the same value as the PTO Engine RPM Set Speed, the engine will not exceed this rpm. The Service Brake Pedal Position switch, Clutch Pedal Position switch, and cab accelerator pedal position sensor circuits are ignored whenever the PTO On/Off switch is ON.

Parameter settings for PTO Configuration Remote Switches with One Speed Above Idle Circuit

Customer Parameter	PTO Configuration	PTO Cab Throttle RPM Limit	PTO TEL	PTO Engine RPM Set Speed	PTO to Set Speed
Parameter Setting	Remote Switches	Not Used	700-TEL	Desired RPM	Yes
Input/Output	Switch input	Output			
Connection	PTO On/Off Circuit	PTO Switch On Lamp			

NOTE: The wiring diagram below is a typical wiring diagram. Other ECM terminals may be used for various parameters that may function differently.

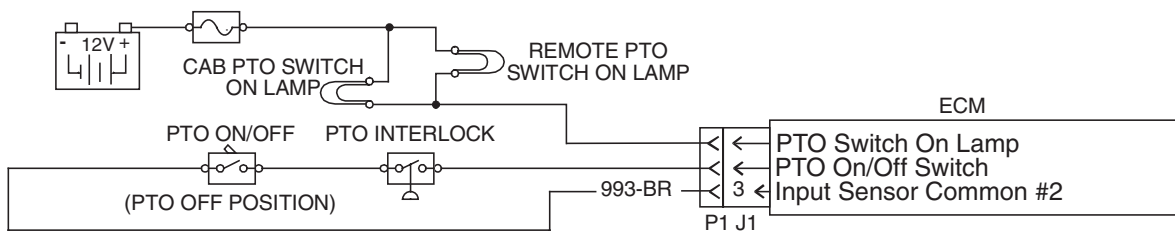


Figure 57 – PTO Configuration Remote Switches with One Speed Above Idle Circuit

16.11.2 One Speed Above Low Idle after PTO Switched On, Using PTO Set/Resume

Program the PTO to Set Speed parameter NO. Program the PTO Top Engine Limit to the same value as the PTO Set Speed. The ECM will not go to the programmed PTO Engine rpm Set Speed until the Set (rpm increase) switch is toggled. If the PTO Top Engine Limit is set to the same value as the PTO Engine rpm Set Speed, the engine will not exceed this rpm.

The service brake pedal position and clutch pedal position switches, and the cab accelerator pedal position sensor circuits are ignored whenever the PTO On/Off switch is ON.

Parameter settings for PTO Configuration Remote Switches with One Speed Above Idle Circuit

Customer Parameter	PTO Configuration	PTO Cab Throttle RPM Limit	PTO TEL	PTO Engine RPM Set Speed	PTO to Set Speed
Parameter Setting	Remote Switches	Not Used	700-TEL	Desired RPM	No
Input/Output	Switch Input	Output	Switch Input	Switch Input	
Connection	PTO On/Off Circuit	PTO Switch On Lamp	PTO Set Switch	PTO Resume Switch	

NOTE: The wiring diagram below is a typical wiring diagram. Other ECM terminals may be used for various parameters that may function differently.

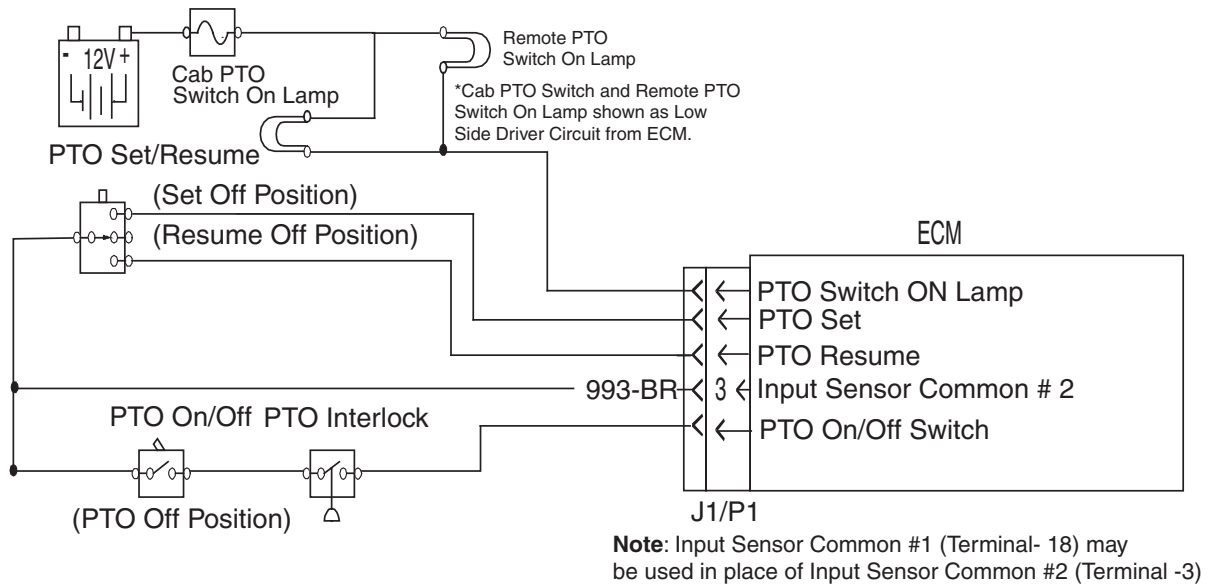


Figure 58 – PTO Configuration Remote Switches with One Speed Above Idle Circuit

16.12 PTO Configuration – Remote Switches with Torque Limiting

If a Torque Limit is programmed it ONLY applies when the Torque Limit Switch is in the ON position. This configuration allows the use of a torque limit switch connected to an ECM Switch Input if Torque Limiting is required. Torque Limiting should only be used for temporary protection of equipment. The programmable parameter Torque Limit Switch must be programmed to a switch to ground input (Default is None).

NOTE: The wiring diagram below is a typical wiring diagram. Other ECM terminals may be used for various parameters that may function differently.

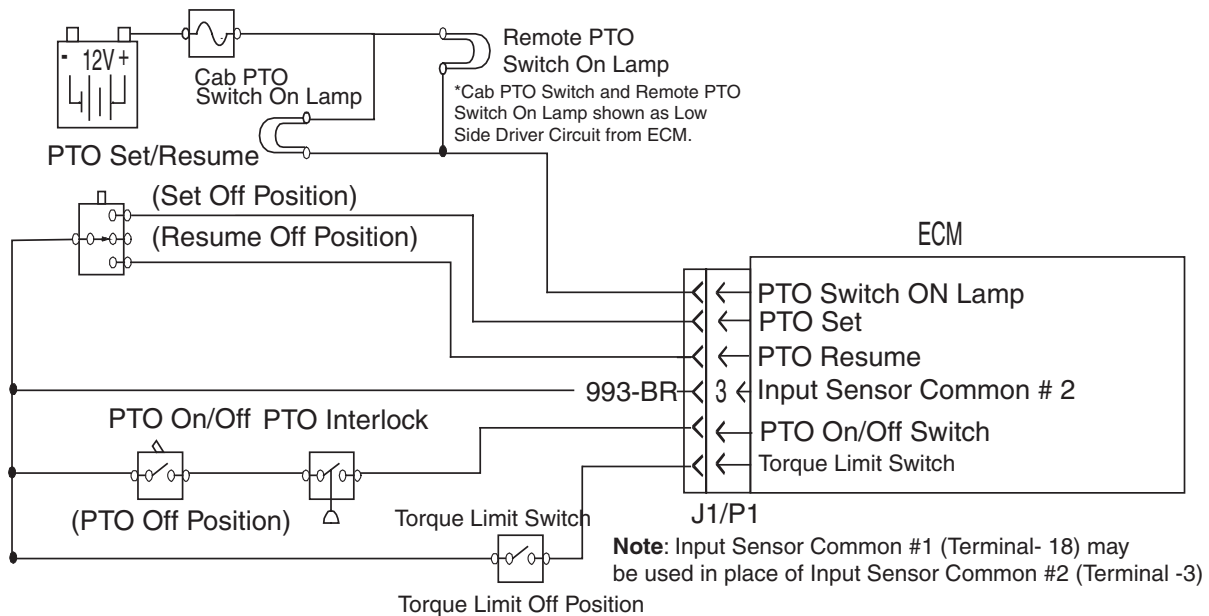


Figure 59 – Remote Switches with Torque Limiting

16.12.1 PTO Configuration – Remote Switches Programmable Options

The following list includes all of the programmable options available for the PTO Configuration Remote Switches. The options listed below are nearly identical to those for the Cab Switches Configuration. PTO will not respond to the cab cruise control switches or the cab throttle when the PTO On/Off circuit is ON.

1. Cruise/Idle/PTO Switch Configuration – affects Remote PTO Switches if PTO Engine RPM Set Speed is not programmed. If PTO Engine RPM Set Speed is programmed, the PTO Set is always increases engine RPM, the PTO Resume is always a RPM decrease.
2. PTO Kickout Vehicle Speed Limit – determines the vehicle speed operating range of the PTO inputs. If vehicle speed exceeds this limit the engine will either not allow an engine speed to be set, or disengage a set PTO speed.
3. Idle/PTO RPM Ramp Rate – determines the rate of engine speed acceleration/deceleration for the PTO and Idle engine speed control.
4. Idle/PTO Bump RPM – determines the amount of rpm increase/decrease if a PTO Set/Resume switch is toggled in the Accel/Decel position. If a PTO Engine RPM Set Speed has been programmed this parameter does not apply.
5. PTO Top Engine Limit – Top RPM Limit of the engine while in PTO mode.
6. PTO Engine RPM Set Speed – program this parameter only if one or two specific engine speed points above low idle are desired. The parameter is bounded by the programmed low idle and PTO Top Engine Limit.
7. PTO to Set Speed – program this parameter to YES if the application wants the engine speed to ramp up to the PTO Engine RPM Set Speed whenever the PTO On/Off circuit is turned ON.
8. PTO Cab Throttle RPM Limit – Not available for Remote Switches.
9. Torque Limit – program this parameter if a lower than rated torque limit is desired in order to temporarily protect equipment. The torque limit will apply whenever the Torque Limit switch is ON.
10. PTO Engine RPM Set Speed A – This parameter can be programmed to a desired set speed that can be attained by turning on a dedicated switch during PTO operation.
11. PTO Engine RPM Set Speed Input A – Use this parameter to select the Set Speed A switch input terminal.
12. PTO Engine RPM Set Speed B – This parameter can be programmed to a desired set speed that can be attained by turning on a dedicated switch during PTO operation.
13. PTO Engine RPM Set Speed Input B – Use this parameter to select the Set Speed B switch input terminal.
14. PTO Shutdown Time – This parameter is programmable between 3 to 1,440 minutes (a value of 0 turns off this feature). This parameter sets the duration of time (in minutes) that engine will operate, with the PTO On/Off circuit ON and no vehicle speed present, before shutting down.
15. PTO Shutdown Timer Maximum RPM – This parameter can be used to reset of the PTO Shutdown Timer if engine speed goes above the programmed PTO Shutdown Timer Maximum RPM. Programming this parameter to 2640 rpm disables this feature.
16. PTO Low Idle Percent Threshold – This parameter enables/disables the PTO Shutdown Timer based on percent engine load during PTO operation.
17. PTO Activates Cooling Fan – This parameter determines if the engine cooling fan is on normally or Continuous while in PTO Mode. The Fan Control Type parameter must be programmed to other than None.
18. Torque Limit Switch – Program this switch input to enable the programmed Torque Limit.
19. PTO Active Output – This output will turn “ON” when PTO is enabled and will remain active until PTO is turned Off or Kicked Out.

16.13 PTO Configuration – Remote Throttle

The Remote Throttle Configuration utilizes a dedicated PTO On/Off, an optional pair of PTO Switch On Lamps (one in cab the other out of the cab at the remote location, and uses a second, additional PTO Accelerator Pedal Position Sensor. This remote throttle **MUST** be connected at all times to prevent illuminating the Amber Warning lamp (connected to ECM Connector P1/J1, terminal-68).

16.13.1 Remote Accelerator Pedal Sensor without Set and Resume

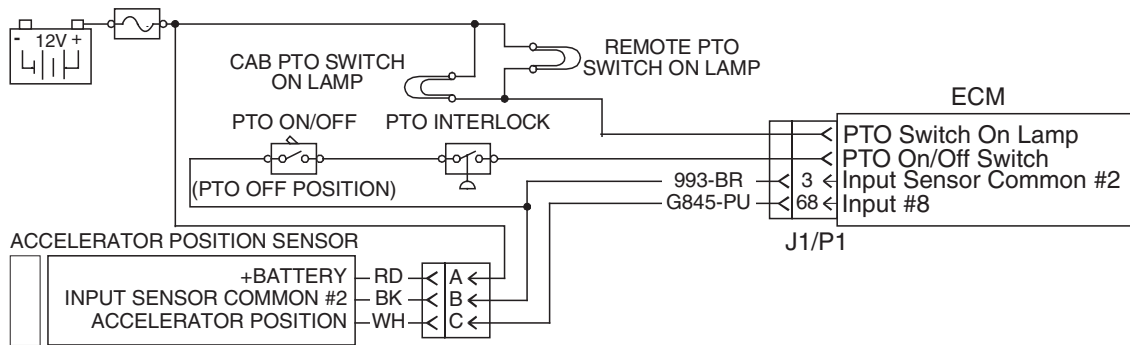
The engine will not exceed the PTO Top Engine Limit with the PTO On/Off Switch ON.

All cab inputs (Cruise, Cruise Pause, Set/Resume, accelerator pedal position sensor, service brake pedal position, transmission neutral, clutch pedal position switches) are ignored when the PTO Configuration is programmed to Remote Throttle and PTO is active.

Parameter settings for PTO Configuration Remote Throttle with One Speed Above Idle Circuit

Customer Parameter	PTO Configuration	PTO to Set Speed	PTO Cab Throttle Limit	PTO TEL	PTO Engine RPM Set Speed
Parameter Setting	Remote Throttle	Not Used	Not Available	700 – TEL	Not available
Input/Output	Switch Input	Input 8#	Output		
Connection	PTO On/Off Circuit	PTO Accelerator Position Sensor	PTO Switch ON Lamp		

NOTE: The wiring diagram below is a typical wiring diagram. Other ECM terminals may be used for various parameters that may function differently.



NOTE: INPUT SENSOR COMMON #1 (TERMINAL-18) MAY BE USED IN PLACE OF INPUT SENSOR COMMON #2 (TERMINAL-3)

Figure 60 – PTO Configuration Remote Throttle

16.13.2 Remote Throttle Sensor with PTO Set and PTO Resume

The remote Set/Resume switches function like the Cab Cruise Control Switches. The engine will not exceed the PTO Top Engine Limit with the PTO On/Off Switch ON.

The Service Brake Pedal Position, Clutch Pedal Position switch, and cab accelerator pedal position sensor circuits are ignored whenever the PTO On/Off switch is ON.

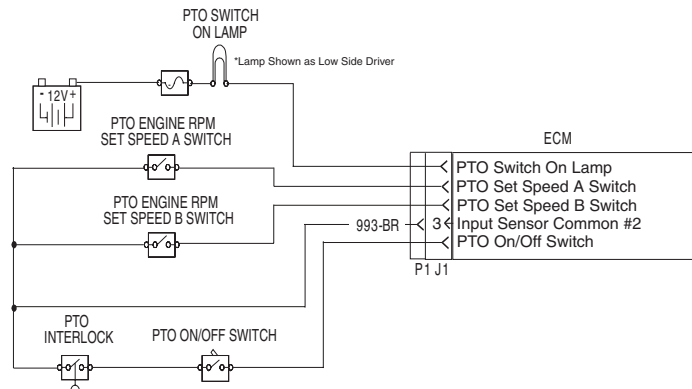
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10. PTO Engine RPM Set Speed A – This parameter can be programmed to a desired set speed that can be attained by turning on a dedicated switch during PTO operation.
11. PTO Engine PM Set Speed – Use this parameter to select the Set Speed A switch input terminal.
12. PTO Engine RPM Set Speed B – This parameter can be programmed to a desired set speed that can be attained by turning on a dedicated switch during PTO operation.
13. PTO Engine RPM Set speed Input B – Use this parameter to select the Set Speed B switch input terminal.
14. PTO Shutdown Time – This parameter is programmable between 3 to 1,440 minutes (a value of 0 turns off this feature). This parameter sets the duration of time (in minutes) that engine will operate, with the PTO On/Off circuit ON and no vehicle speed present, before shutting down.
15. PTO Shutdown Timer Maximum RPM – This parameter can be used to reset the PTO Shutdown Timer if engine speed goes above the programmed PTO Shutdown Timer Maximum RPM. Programming this parameter to 2,640 rpm disables this feature.
16. PTO Low Idle Percent Threshold – This parameter enables/disables the PTO Shutdown Timer based on percent engine load during PTO operation.
17. PTO Activates Cooling Fan – This parameter determines if the engine cooling fan is on normally or continuous while in PTO Mode. The Fan Control type parameter must be programmed to other than None.
18. Torque Limit Switch – Program this switch input to enable the programmed Torque Limit.
19. PTO Active Output – This output will turn “ON” when PTO is enabled and will remain active until PTO is turned Off or Kicked Out.

*Parameter settings for PTO Configuration Remote Throttle with Set Speed A and B

Customer Parameter	PTO Configuration	PTO Engine RPM Set Speed Input A	PTO Engine RPM Set Speed A	PTO Engine RPM Set speed Input B	PTO Engine RPM Set Speed B
Parameter Setting	Cab Switches, Remote Switches or Remote Throttle	J1/P1:Option	Desired RPM	J1/P1:Option	Desired RPM
Input/Output	Switch Input	Switch Input	Switch Input	Output	
Connection	PTO On/Off Circuit	Set Speed A Switch Circuit	Set Speed B Switch Circuit	PTO Switch On Lamp	

NOTE: The wiring diagram below is a typical wiring diagram. Other ECM terminals may be used for various parameters that may function differently.



NOTE: INPUT SENSOR COMMON #1 (TERMINAL-18) MAY BE USED IN PLACE OF INPUT SENSOR COMMON #2 (TERMINAL-3)

Figure 62 – PTO Configuration with PTO Engine RPM Set Speed A and B

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16.14 PTO Configuration – Remote Throttle & J1939 Speed Command

The Remote Throttle & J1939 Speed Command Configuration utilizes a dedicated PTO On/Off, a second, additional PTO Accelerator Pedal Position Sensor, and a J1939 device that broadcasts TSC 1 Speed Commands.

The hardwired remote throttle **MUST** be connected at all times to prevent illuminating the Amber Warning Lamp (connected to ECM Connector P1/J1, terminal-68).

The ECM will only listen to TSC 1 speed commands to control engine speed during PTO operation from the two sources defined by SAE. Management Computer #1 (\$27 hex) and Water Pump Controller (\$39 hex) can control engine speed using the TSC1 speed command. The ECM will listen to TSC 1 Speed Commands during PTO operation only.

TSC 1 Speed Commands from the ABS and/or transmission override all other TSC 1 commands.

TSC 1 Speed Commands should only be broadcast when the controlling device needs to control engine speed. Once the TSC 1 Speed Command is no longer broadcast, the engine speed will go to low idle, hardwired remote throttle desired engine speed, or to a pre-established set speed.

No diagnostics are associated with TSC 1 Speed Commands.

16.14.1 Remote Accelerator Pedal Sensor & J1939 Speed Command without Set and Resume

The engine will not exceed the PTO Top Engine Limit with the PTO On/Off Switch ON.

All cab inputs (Cruise, Cruise Pause, Set/Resume, accelerator pedal position sensor, service brake pedal position, transmission neutral, clutch pedal position switches) are ignored when the PTO Configuration is programmed to Remote Throttle & J1939 Speed Command; and PTO is active.

Parameter settings for PTO Configuration Remote Throttle & J1939 Speed Command with One Speed Above Idle Circuit.

Customer Parameter	PTO Configuration	PTO to Set Speed	PTO Cab Throttle Limit	PTO TEL	PTO Engine RPM Set Speed
Parameter Setting	Remote Throttle & J1939 Speed Command	Not Used	Not Available	700 – TEL	Not available
Input/Output	Switch Input	Input 8#	Output		
	J1939 Data Link Device	J1939 Data Link	Output		
Connection	PTO On/Off Circuit	PTO Accelerator Position Sensor	PTO Switch ON Lamp		

NOTE: The wiring diagram below is a typical wiring diagram. Other ECM terminals maybe used for various parameters that may function differently.

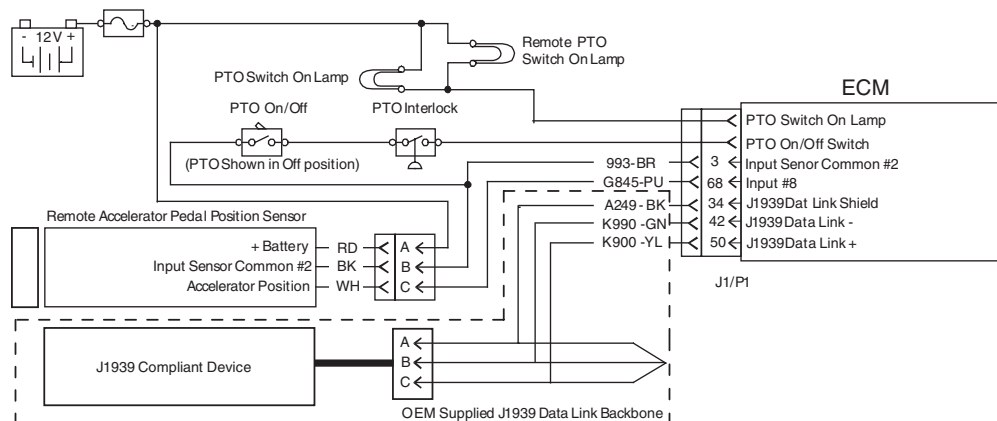


Figure 63 – PTO Configuration Remote Throttle & J1939 Speed Control

16.14.2 Remote Throttle & J1939 Speed Command with PTO Set and PTO Resume

The remote Set/Resume switches function like the Cab Cruise Control Switches. The engine will not exceed the PTO Top Engine Limit with the PTO On/Off Switch ON.

The Service Brake Pedal Position, Clutch Pedal Position switch, and cab accelerator pedal position sensor circuits are ignored whenever the PTO On/Off switch is ON.

Parameter settings for PTO Configuration Remote Throttle with Set/Resume

Customer Parameter	PTO Configuration	Idle/PTO Ramp Rate	Idle/PTO Bump RPM	PTO TEL	PTO Engine RPM Set Speed
Parameter Setting	Remote Throttle & J1939 Speed Command	5 to 1,000 rpm/sec	5 to 500 rpm	700 – TEL	Not used
Input/Output	Switch Input	Input #8	Output	Switch	Switch Input
	J1939 Data Link Device	J1939 Data Link	Output		
Connection	PTO On/Off Circuit	Remote Accelerator Position Sensor	PTO Switch ON Lamp	PTO Set Switch	PTO Resume Switch

NOTE: The wiring diagram below is a typical wiring diagram. Other ECM terminals may be used for various parameters that may function differently.

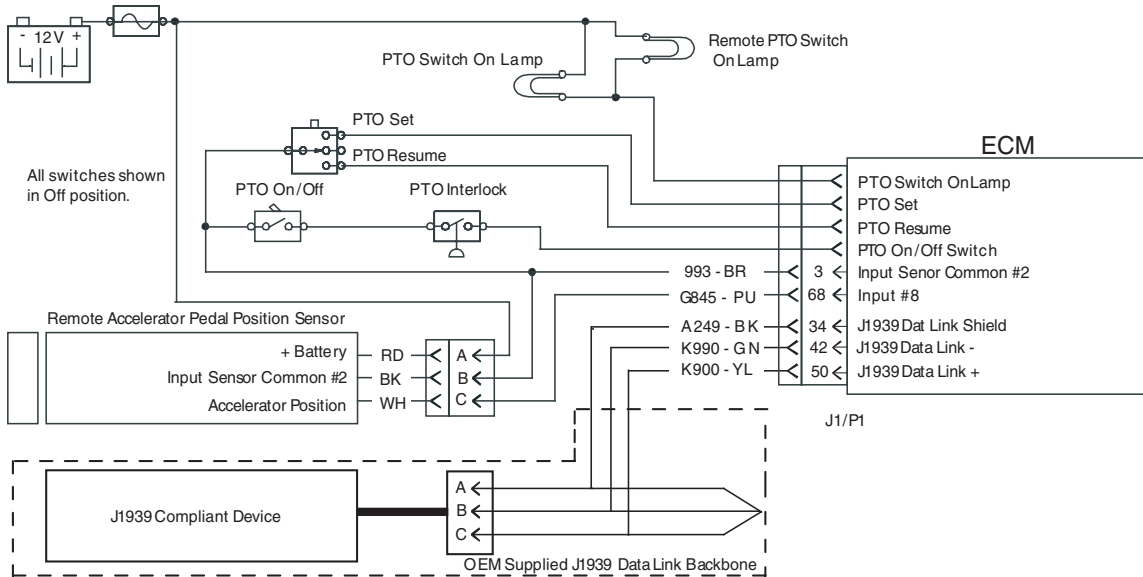


Figure 64 – PTO Configuration Remote Throttle & J1939 Speed Command with Remote Set/Resume

16.14.3 PTO Configuration – Remote Throttle & J1939 Speed Command Programmable Options

The following list includes all of the programmable options available for the PTO Configuration Remote Throttle & J1939 Speed Command. PTO will not respond to the cab cruise control switches or the cab throttle when the PTO On/Off circuit is ON.

1. Cruise/Idle/PTO Switch Configuration – determines the function of the Set and Resume inputs when held in position or toggled. The two options are Set-Accel, Resume-Decel, or Set-Decel, Resume Accel. This applies to cruise control, PTO, and idle modes of operation.
2. PTO Kickout Vehicle Speed Limit – determines the vehicle speed operating range of the PTO inputs. If vehicle speed exceeds this limit the engine will either not allow an engine speed to be set, or disengage a set PTO speed.
3. Idle/PTO RPM Ramp Rate – determines the rate of engine speed acceleration/deceleration for the set, resume, accel, and decel operation. Applies to both PTO and Idle engine speed control.
4. Idle/PT Bump RPM – determines the amount or rpm increase/decrease when the Remote PTO Set/Resume switch is toggled in the Accel/Decel position.
5. PTO Top Engine Limit – Top RPM Limit of the engine when the PTO On/Off circuit is ON.
6. PTO Engine RPM Set Speed – this parameter is not available if the PTO Configuration is Remote Throttle & J1939 Speed Command.
7. PTO to Set Speed – this parameter is not available if the PTO Configuration is Remote Throttle & J1939 Speed Command.
8. PTO Cab Throttle RPM Limit – programming this parameter has no affect for the PTO Configuration Remote Throttle & J1939 Speed Command.
9. Torque Limit – program this parameter if a lower than rated torque limit is desired in order to temporarily protect equipment. The torque limit will apply whenever the Torque Limit switch is ON.
10. PTO Engine RPM Set Speed A – This parameter can be programmed to a desired set speed that can be attained by turning on a dedicated switch during PTO operation.
11. PTO Engine PM Set Speed Input A – Use this parameter to select the Set Speed A switch input terminal.
12. PTO Engine RPM Set Speed B – This parameter can be programmed to a desired set speed that can be attained by turning on a dedicated switch during PTO operation.
13. PTO Engine RPM Set speed Input B – Use this parameter to select the Set Speed B switch input terminal.
14. PTO Shutdown Time – This parameter is programmable between 3 to 1,440 minutes (a value of 0 turns off this feature). This parameter sets the duration of time (in minutes) that engine will operate, with the PTO On/Off circuit ON and no vehicle speed present, before shutting down.
15. PTO Shutdown Timer Maximum RPM – This parameter can be used to reset the PTO Shutdown Timer if engine speed goes above the programmed PTO Shutdown Timer Maximum RPM. Programming this parameter to 2,120 rpm disables this feature.
16. PTO Low Idle Percent Threshold – This parameter enables/disables the PTO Shutdown Timer based on percent engine load during PTO operation.
17. PTO Activates Cooling Fan – this parameter determines if the engine-cooling fan is on normally or continuous while in PTO Mode. The Fan Control type parameter must be programmed to other than none.
18. Torque Limit Switch – Program this switch input to enable the programmed Torque Limit.
19. PTO Active Output – This output will turn “ON” when PTO is enabled and will remain active until PTO is turned off or Kicked Out.

16.15 Multiple Speed PTO Operation using PTO Engine RPM Set Speed A and B

Multiple Speed PTO operation can be utilized for all four PTO Configurations available (Cab Switches, Remote Switches, Remote Throttle, or Remote Throttle & J1939 Speed Control). This feature provides a simple means to add one or two additional set speeds that can be actuated by turning on a dedicated switch(es) for the programmed speed(s).

For multiple speed PTO operation the PTO Engine RPM Set Speed Input A parameter can be programmed to use any one of the multiple switch inputs on the ECM. The corresponding PTO Engine RPM Set Speed A parameter can be programmed to the desired operating speed. When the switch between the selected input and sensor common is closed, the engine will proceed to the programmed speed for that input while operating in Dedicated PTO Mode (PTO On/Off Switch ON).

For an additional set speed input, the PTO Engine RPM Set Speed Input B parameter can be programmed to use any of the other multiple inputs not selected from the choices mentioned above. Program the corresponding PTO Engine RPM Set Speed B parameter to the desired speed. When the switch between the selected input and sensor common is closed, the engine will proceed to the programmed speed, for that input, while the engine is operating in Dedicated PTO Mode (PTO On/Off Switch ON), and the PTO Engine RPM Set Speed Input A is OFF.

When the PTO On/Off Switch is turned ON, and a PTO Engine RPM Set Speed Input Switch (A or B) is already ON, or then turned ON, the engine will proceed to the corresponding rpm programmed for that switch. If both switches are ON, the engine will proceed to PTO Engine RPM Set Speed A. PTO Engine RPM Set Speed Input A has priority over PTO Engine RPM Set Speed Input B. If switch A is then turned OFF, the engine will proceed to the programmed PTO Engine RPM Set Speed B. If switch A is then turned ON again, the engine will proceed back to PTO Engine RPM Set Speed A. If both switches are turned OFF the engine will then return to Low Idle.

The PTO Engine RPM Set Speeds A and B can be used with all other PTO features used to control engine rpm with the exception of conditions that disable PTO operation or cause a “kickout”. For Example, the Cab Throttle, Remote Throttle, Cruise Set/Resume, and Remote Set/Resume Inputs as well as the PTO to Set Speed feature are all ignored when either PTO Engine RPM Set Speed Input Switch (A or B) is ON. When the switch is turned OFF, normal control is returned.

Applications using the Dedicated PTO Configuration of Remote Throttle & J1939 Speed Command can utilize the Set Speed A and B functions. TSC 1 commands have priority over the hardwired remote throttle and all set speeds, including PTO Engine RPM Set Speeds A and B.

When a single PTO Set Speed Input Switch (A or B) is turned On, the PTO Set Speed will be changed from the previous PTO Set Speed value (created by the Set/Resume Switch) to the programmed PTO Engine RPM Set Speed (A or B). When that PTO Set Speed Input Switch is turned Off, the PTO Set Speed is changed to Low Idle. The Set/Resume switch will need to be used to create a PTO Set Speed above Low Idle.

NOTE: The PTO to Set Speed feature is only available for Cab Switches and Remote Switches configurations. If the PTO to Set Speed parameter is programmed to YES and a PTO Engine RPM Set Speed is programmed, the engine will automatically go to that programmed speed when the PTO On/Off Switch is turned ON. However, if either PTO Engine RPM Set Speed Input Switch (A or B) is ON, the engine will operate at the corresponding rpm programmed for that switch. When the A or B switch is turned OFF, the engine will proceed to the PTO Engine RPM Set Speed. If the PTO to Set Speed parameter is programmed to NO, the engine will return to Low Idle when the PTO Engine RPM Set Speed Input Switch (A or B) is turned OFF.

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16.16 PTO Operation Examples

Multiple PTO Engine Speed Operation – Example #1

PTO, multiple engine speeds

Hard Wired Switch inputs

- 1) PTO Configuration set to Cab Switches or Remote Switches.
- 2) For Set Engine speeds above Low Idle

Parameter	Parameter Setting	
PTO TEL	1,500 rpm	1,500 rpm
**PTO to Set Speed	**Yes	**No
PTO Set Speed	1,200 rpm	1,200 rpm
Switch Input	Engine speed reaction	Engine speed reaction
PTO Enable	**Engine goes to 1,200 rpm	**Engine stays at low idle
*Set/Accel	If at 1,200 rpm, toggle once to go to 1,500 rpm. N/A at 1,500 rpm.	If at low idle, toggle once to go to 1,200 rpm. Toggle again to go to 1,500 rpm. N/A at 1,500 rpm.
*Resume/Decel	N/A if at Low Idle. If at 1,500 rpm Toggle once to go to 1,200 rpm. Toggle again to go to low idle.	N/A if at Low Idle. If at 1,500 rpm toggle once to go to 1,200 rpm. Toggle again to go to low idle.

Notes:

**Notice difference in function with different “PTO To Set Speed” parameter settings.

With “PTO Set Speed” parameter programmed to an engine rpm, the “Cruise/Idle/PTO Switch Configuration” parameter setting has no affect on the cab cruise “Set” and “Resume” switches.

For one desired speed above low idle, set the “PTO Set Speed” and the “PTO TEL” to the same rpm value. Throttle can override “PTO Set speed” rpm up to PTO TEL.

The “Set” switch will not set “PTO Set Speed” to the throttle controlled engine speed.

16.17 Multiple PTO Engine Speed Operation – Example #2

PTO, multiple engine speeds

Hard Wired Switch Inputs

- 1) PTO engine rpm control with Set Speed A and B
- 2) PTO Configuration set to Cab Switches, Remote Switches or Remote Throttle.

Parameter	Parameter Setting
PTO TEL	1,500 rpm
Set Speed A	1,000 rpm
Set Speed B	1,200 rpm
PTO to Set Speed	No (N/A for Remote Throttle)
Switch Input	Engine Speed reaction
PTO Enable	Engine Stays at Low Idle
Set Speed A	Engine speed ramps to 1,000 rpm
Set Speed B	If Set Speed A is Off, engine speed ramps to 1,200 rpm

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Notes:

- 1) Set Speed A and B switch inputs must be programmed.
- 2) Set Speed A overrides Set Speed B, Cruise Accel, Cruise Decel, PTO Set Speed and Throttle.
- 3) Set Speed B overrides Cruise Accel, Cruise Decel, PTO Set Speed and Throttle.
- 4) If PTO To Set Speed is programmed to No, switching A or B off returns the PTO Set Speed to Low Idle.
- 5) If PTO To Set Speed is programmed to YES, switching A or B off returns to the programmed PTO Engine RPM Set Speed to Low Idle.

16.18 Multiple PTO engine speed Example #3

PTO, multiple engine speeds

Hard Wired Switch Inputs

- 1) PTO Configuration set to Cab Switches, Remote Switches.
- 2) To get variable engine speeds above low idle:

Parameter	Parameter Setting
PTO TEL	1,500 rpm
PTO To Set Speed	No
PTO to Set Speed	0
Idle/PTO Ramp Rate	50 rpm/sec
Idle/PTO Bump Rate	20 rpm
Switch Input	Engine Speed Reaction
PTO Enable	Engine Stays at Low Idle
*Set/Accel	Toggle once to set "PTO Set Speed" at current engine speed. Toggle to 'Bump' 20 rpm (up to 1,500 rpm) Hold to 'Ramp' up @ 50 rpm/sec (up to 1,500 rpm). N/A at 1,500 rpm.
*Resume/Decel	N/A if PTO Set Speed not set. N/A if at Low Idle Toggle to 'Bump' down 20 rpm (to Low Idle). Hold to 'Ramp' down @ 50 rpm/sec (to Low Idle)

*Notes:

- 1) *The "Cruise/Idle PTO Switch Configuration" parameter setting does affect the Remote PTO Set and Resume switches.
- 2) Throttle can override 'PTO Set Speed' rpm up to PTO TEL.
- 3) The 'Set' switch will set 'PTO Set Speed' to the throttle controlled engine speed.
- 4) Remote PTO Set and Resume switch inputs must be programmed for Remote Switches, Remote Throttle, and Remote Throttle & J1939 Speed Command.

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16.19 Multiple PTO engine speed Example #4

PTO, multiple engine speeds

J1939 Based Cruise Switch Input Messages

- 1) PTO Configuration set to Cab Switches.
- 2) For set engine speeds above Low Idle:

Parameter	Parameter Setting	
PTO TEL	1,500 rpm	1,500 rpm
**PTO To Set Speed	**YES	**NO
PTO Set Speed	1,200 rpm	1,200 rpm
Switch Input	Engine Speed reaction	Engine Speed reaction
PTO Enable	**Engine goes to 1,200 rpm ("PTO Set Speed" has been set)	**Engine stays at Low Idle
J1939 Set Message	N/A ("PTO Set Speed" has been set)	Toggle once to raise RPM to 1,200 rpm. ("PTO Set Speed" has been set) N/A once a "PTO Set Speed" has been established
J1939 Resume Message	N/A	N/A
J1939 Cruise Accel Message	If at Low Idle, Toggle once to go to 1,200 rpm. Toggle again to go to 1,500 rpm. N/A at PTO TEL (1,500 rpm)	After "PTO Set Speed" has been established. If at Low Idle, toggle once to go to 1,200 rpm. Toggle again to go to 1,500 rpm. N/A at PTO TEL (1,500 rpm)
J1939 Decel Message	N/A if at Low Idle If at 1,500 rpm toggle once to go to 1,200 rpm. Toggle again to go to low idle.	N/A if at Low Idle If at 1,500 rpm toggle once to go to 1,200 rpm. Toggle again to go to Low Idle.

Notes:

- 1) **Notice difference in function with different "PTO To Set Speed" parameter settings.
- 2) For one desired speed above low idle, set the "PTO Set Speed" and the "PTO TEL" to the same rpm value.
- 3) Throttle can override 'PTO Set Speed' rpm up to PTO TEL.
- 4) The 'Set' switch message will not set 'PTO Set Speed' to the throttle controlled engine speed.
- 5) The ECM will respond to the J1939 base PTO Engine RPM Set Speed A message just as the hardwired switch input.

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16.20 Multiple PTO engine speed Example #5

PTO, multiple engine speeds

J1939 Based Cruise Switch Input Messages

- 1) PTO Configuration set to Cab Switches
- 2) For variable engine speeds above Low Idle:

Parameter	Parameter Setting
PTO TEL	1,500 rpm
PTO To Set Speed	No
PTO Set Speed	0
Idle/PTO Ramp Rate	50 rpm/sec
Idle/PTO Bump Rate	20 rpm
Switch Input	Engine Speed Reaction
PTO Enable	Engine Stays at Low Idle
J1939 Cruise Set Message	Toggle once to set "PTO Set Speed" at current engine speed.
J1939 Cruise Resume Message	N/A
J1939 Cruise Accel Message	Toggle to bump up 20 rpm. Hold to Ramp Up @ 50 rpm/sec
J1939 Cruise Decel Message	If above Low Idle, toggle to bump down 20 rpm. Hold to Ramp Down @50 rpm/sec

Notes:

The ECM will respond to the J1939 message (PGN 65,264) (\$FEF) Byte 6, Bits 4-3 ("Remote PTO preprogrammed speed control switch") in the same manner as the PTO Engine RPM Set speed A hardwired switch input.

The "Cruise/Idle/PTO Switch Configuration" parameter setting does affect the J1939 Remote PTO Set and Resume switch messages.

16.21 Multiple PTO engine speed Example #6

PTO, multiple engine speeds

J1939 Based Switch Remote PTO Set and Resume Message Inputs

- 1) PTO Configuration set to Remote Switches, Remote Throttle or Remote Throttle & J1939 Speed Control.
- 2) For variable engine speeds.

Parameter	Parameter Setting
PTO TEL	1,500 rpm
PTO To Set Speed	No (N/A for Remote Throttle or Remote Throttle & J1939 Speed Control)
PTO Set Speed	0 (N/A for Remote Throttle or Remote Throttle & J1939 Speed Control)
Idle/PTO Ramp Rate	50 rpm/sec
Idle/PTO Bump Rate	20 rpm
Switch Input	Engine Speed Reaction
PTO Enable	Engine Stays at Low Idle
J1939 Remote PTO Set Message	Toggle once to set 'PTO Set Speed' at current engine speed. Toggle to bump up 20 rpm. Hold to ramp up @ 50 rpm/sec
J1939 Remote PTO Resume Message	If above Low Idle, toggle to bump down 20 rpm. Hold to ramp down @ 50 rpm/sec
J1939 Remote PTO Accel Message	Not supported
J1939 Remote PTO Decel Message	Not supported

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Notes:

- 1) The ECM will respond to the J1939 message (PGN65,264 (\$FEF) Byte 6 Bits 4-3 “Remote PTO preprogrammed speed control switch”) in the same manner as the PTO Engine RPM Set Speed A hardwired switch input.
- 2) The “Cruise/Idle/PTO switch configuration” parameter does affect the J1939 Remote PTO Set and Resume switch messages.

16.22 Multiple PTO engine speed Example #7

PTO, multiple engine speeds

J1939 Based Switch Remote PTO Set & Resume Message Inputs

- 1) PTO Configuration set to Remote Switches.
- 2) For set engine speeds above low idle:

Parameter	Parameter Setting	
PTO TEL	1,500 rpm	1,500 rpm
PTO To Set Speed	Yes	No
PTO Set Speed	1,200 rpm	1,200 rpm
Idle/PTO Ramp Rate	50 rpm/sec	50 rpm/sec
Idle/PTO Bump Rate	20 rpm	20 rpm
Switch Input	Engine Speed Reaction	Engine Speed Reaction
PTO Enable	**Engine goes to 1,200 rpm	Engine Stays at low idle
J1939 Remote PTO Set Message	Toggle and engine goes to 1,200 rpm	Toggle to increase rpm to 1,200 rpm. Toggle and engine goes to 1,500 rpm
J1939 Remote PTO Resume Message	N/A @ low idle @ 1,500 rpm, toggle to reduce engine rpm to 1,200 rpm @ 1,200 rpm, toggle to reduce engine rpm to Low Idle	N/A @ low idle @ 1,500 rpm, toggle to reduce rpm to 1,200 rpm @ 1,200 rpm, toggle to reduce rpm to Low Idle
J1939 Remote PTO Accel Message	Not supported	Not supported
J1939 Remote PTO Decel Message	Not supported	Not supported

Notes:

- 1) The ECM will respond to the J1939 message (PGN 65,264 (\$FEF) Byte 6 Bits 4-3 “Remote PTO preprogrammed speed control switch”) in the same manner as the PTO Engine RPM Set Speed A hardwired switch input.
- 2) The “Cruise/Idle/PTO Switch Configuration” parameter setting does affect the J1939 Remote PTO Set and Resume switch messages.

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16.23 Multiple PTO engine speed Example #8

PTO, multiple engine speeds

Remote PTO Set & Resume

- 1) PTO Configuration set to Remote Throttle & J1939 Speed Control.
- 2) For set engine speeds above low idle:

Parameter	Parameter Setting
PTO TEL	1,500 rpm
PTO To Set Speed	N/A
PTO Set Speed	N/A
Idle/PTO Ramp Rate	50 rpm/sec
Idle/PTO Bump Rate	20 rpm
Switch Input	Engine Speed reaction
PTO Enable	Engine Stays at low idle
TSC1 Speed Command received	Engine goes to speed requested. Engine will not exceed PTO TEL
Remote PTO Set Switch On	Engine goes to speed requested. Engine will not exceed PTO TEL TSC 1 speed request overrides set speed
Remote PTO Resume	Engine goes to speed requested. Engine will not exceed PTO TEL TSC 1 speed request overrides resume speed

Notes:

- 1) The ECM will respond to the J1939 TSC1 Speed Command message in the same manner as the hardwired Remote Throttle.
- 2) ECM will respond in the same manner for both hardwired and J1939 Remote PTO Set and Remote PTO Resume Switches.

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16.24 Multiple PTO engine speed Example #9

PTO, multiple engine speeds

Engine RPM Set Speed A,B, and Hardwired Remote Throttle

- 1) PTO Configuration set to Remote Throttle & J1939 Speed Control.
- 2) For set engine speeds above low idle:

Parameter	Parameter Setting
PTO TEL	1,500 rpm
PTO To Set Speed	N/A
PTO Set Speed	N/A
Engine RPM Set Speed A	1000 rpm
Engine RPM Set Speed B	1200 rpm
Engine RPM Set Speed Input A	J1/P1: 6, 7, 22, 23, 35, 40, 44, 45, 46, 47, 56, 58, 59, 60, J1939 Body Controller, J1939 Cab Controller, J1939 Instrument Cluster J1939 Cab Display
Engine RPM Set Speed Input B	J1/P1: 6, 7, 22, 23, 35, 40, 44, 45, 46, 47, 56, 58, 59, 60
Switch Input	Engine Speed reaction
PTO Enable	Engine Stays at low idle
Hardwired Throttle Input	Engine goes to throttle desired engine speed. Set Speed A, B, TSC 1 speed command override hardwired throttle.
PTO Set Speed A input On	Engine goes to 1,000 rpm. Overrides hardwired throttle desired engine speed. Overrides set speed B if on. TSC 1 Speed Command overrides A, engine goes to desired speed.
PTO Set Speed B On	Overrides hardwired throttle desired engine speed. Engine goes to 1,200 rpm if Set Speed A is Off TSC 1 Speed Command overrides B, engine goes to desired speed.

Notes:

The ECM will respond to the J1939 TSC1 Speed Command message in the same manner as the hardwired Remote Throttle.