

GM PTO Systems; Part 1



by Steve Garrett

The operation of a Power Take Off (PTO) is nothing new for most of you. But, as with other vehicle systems, the PTO has undergone a lot of changes in the past few years.

PTOs provide an inexpensive, reliable and safe way to drive several vehicle accessories, such as:

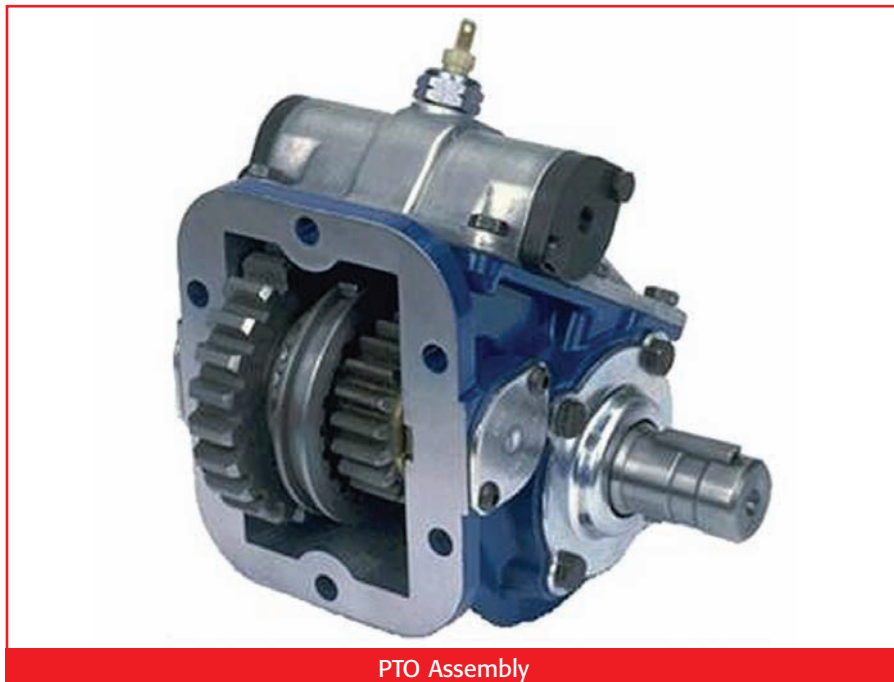
- Winches
- Road Sanders
- Dump Boxes
- Snow Plows
- Man Lifts
- Fire and Ambulance Equipment
- Drills
- Air Compressors
- Wreckers

A PTO unit is commonly bolted to the transmission, transfer case or engine, or in some cases may be operated from an accessory drive belt. In any case, the PTO is typically a gear-driven assembly that directly or indirectly operates a hydraulic pump and PTO hydraulic system.

Some systems don't use a PTO to operate a pump, but rather the PTO operates a driveshaft, which is then used to drive a component. Early applications used a lever system to engage and disengage the PTO. On later applications, this operation is typically controlled electronically.

With GM applications, many of the PTO system components can't be ordered as options when you purchase a new vehicle. Instead, GM uses GM dealers or independent "upfitters" to install many of the components required to make the PTO system function.

GM typically offers two RPO (Regular Production Option) codes that relate to the PTO system. RPO UF3 designates the vehicle is equipped with *fast idle* software. The UF3 option



PTO Assembly

allows the vehicle to operate at a single elevated speed when activated. This feature typically increases engine RPM, which improves alternator output, A/C cooling, and heater performance when the vehicle is stationary. This option comes with a cab mounted switch, wiring and a PCM or ECM capable of raising idle speed when needed. The fast idle option wasn't designed to operate the PTO system.

RPO PTO may be ordered on many applications. This option provides the upfitter with factory-installed wiring to make installation simpler. In addition, it provides multiple or variable engine speeds to meet current demands. Engine speeds are programmable on some applications. The factory PTO option includes:

- A PTO enable switch
- Cruise control switches that are used to vary engine speed for PTO operation
- Upfitter wiring and connections for an in-cab PTO switch

- Upfitter interface connector located on the driver's side of the transmission (passenger side 2007-09 applications)
- A programmable PCM or ECM with PTO software
- TAC module (on electronic throttle controlled systems)
- PTO module (included in RPO PTO on 2007-08 applications)

Some applications also require an RPO MIF option. This option features a revised floorpan. The floorpan has a kickout design to provide the required space for transmission-mounted PTOs.

GM offers PTO installation kits through two suppliers: Chelsea Auxiliary Power Products and Muncie Power Products. The PTO installation kits include:

- Plumbing
- PTO
- Heat Shields
- PTO Control Switch (included in RPO PTO on 2007-08 applica-

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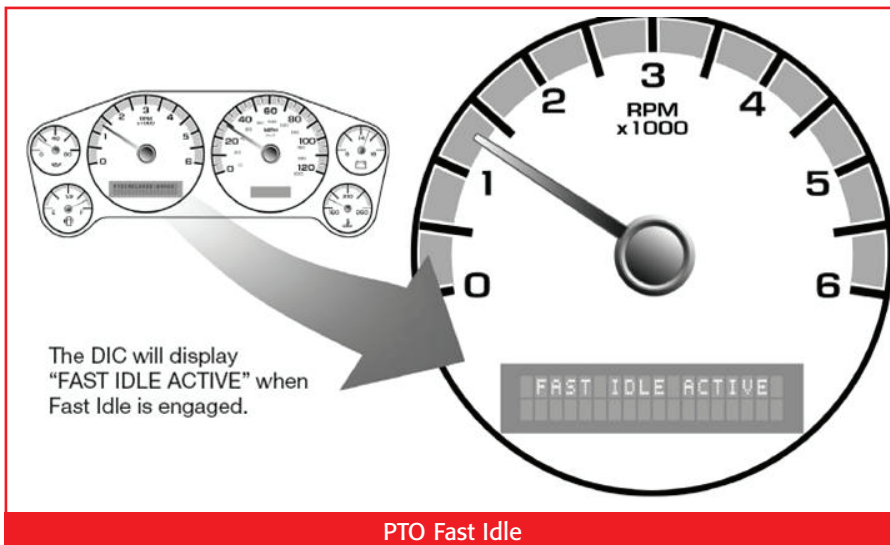
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- tions)
- PTO Interface Harness (included in RPO PTO on 2007-08 applications)
- Load Engagement Switch (some applications)
- PTO Solenoid (some applications)

The PTO installation kit allows the PTO system to be installed on properly equipped 4L80E, LCT 1000 and the ZF 6-speed manual transmission applications.

PTO Components

PTO Drive Gear — Not all applications are equipped to handle a PTO. The LCT 1000 may or may not be equipped with a PTO drive gear, depending on the year and application. These models are equipped for PTO operation:

- All 2001-2006 8.1 RPO L18 (VIN code G) and 2001-2004 6.6 RPO LB7 (VIN code 1)
- All 2004-2008 6.6 RPO LLY (VIN code 2), 2006-2008 6.6 RPO LBZ (VIN code D), 2007-2008 6.6 RPO LMM (VIN code 6) and 2007 8.1 RPO L18 (VIN code G)
- Trucks with RPO ZW9 don't have a PTO drive gear unless they're 2007 and prior model years equipped with an 8.1L, RPO L18.

If the application isn't equipped for a PTO, the PTO gear may be ordered as part of a rotating housing assembly. The 2001-05 rotating assembly is GM part number 29540518. The 2006-and-later rotating assembly is GM part number 29542802.

NOTE: GM doesn't recommend installing a PTO on non-factory PTO applications on 2007-and-later vehicles. 2007-and-later applications have undergone significant changes and adding a PTO is no longer a cost effective choice.

PTO Control Switch — The PTO switch generally uses two or three positions: Off, On and on some applications Set. The PTO switch acts as the main controlling component for the GM PTO system.

PTO Interface Connector — This connector is located on a bracket on the driver's side of the transmission (passenger side 2007-09 applications). The interface connector provides access to these circuits:

- PTO engine shutdown (Light Blue)
- PTO remote enable switch (Light Green)
- Ground (Black)
- PTO feedback (Yellow)
- PTO relay control (White)
- Cruise control switch (Dark Blue)

PCM/ECM — The PCM/ECM for PTO applications can be programmed to control the PTO as well as engine RPM (2006 and earlier). Two modes of PTO operation are typically available:

- Preset — In this mode the PCM typically uses one of two preset PTO operating speeds.
- Variable — This mode allows variable PTO speed while the vehicle is stationary or moving.

PTO Relay — The PTO relay

is controlled by the PCM/ECM. The PCM/ECM receives input from the PTO switch. When the PTO is commanded on or off, the PCM/ECM will correspondingly command the relay on or off when the required parameters have been met.

The PTO relay is mounted in the underhood fuse box (UBEC). The engine 1 fuse and the PTO switch typically control the power to the relay winding, while the PCM/ECM controls the relay ground.

NOTE: The PTO relay is an upfitter-installed device on some later model applications and is now controlled by the Power Take Off Module (PTOM).

Cruise Control Switch — On vehicles that are equipped with cruise control, the cruise control switch assembly is typically used to control PTO operation. The switch can be used to turn the PTO on and off, and set the PTO speed.

TCC — Several automatic transmission applications apply the TCC during PTO operation. This typically occurs when the vehicle is in park and the engine speed is above 1100 RPM with the PTO engaged.

Brake Switch/Clutch Switch — The brake switch/clutch switch is used to cancel PTO operation as a safety precaution on factory applications. On some applications (typically diesel) when the brake/clutch is released, the system will resume operation. Other applications require the operator to depress the set switch or touch the resume button on the cruise control switch to resume operation.

TAC Module — On electronic, throttle-controlled applications, the Throttle Actuator Control (TAC) module is used to regulate engine RPM. Based on data received from the PCM/ECM, the TAC module will raise or lower engine RPM to meet the demand. This is accomplished as the TAC module changes the commands to the TAC motor.

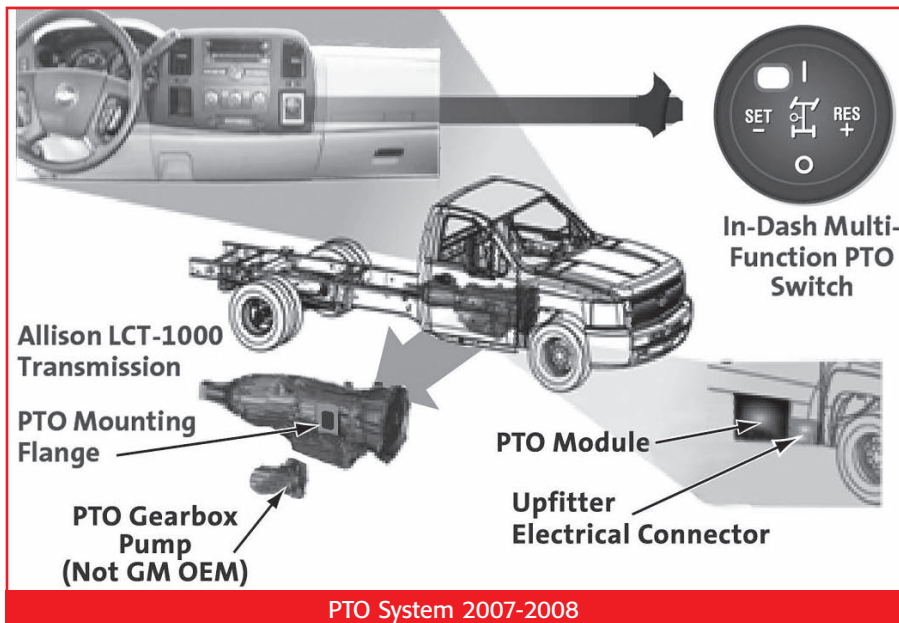
PTO Solenoid — The PTO solenoid is an upfitter-installed device. Many systems require a solenoid for clutch activated PTOs. The PTO relay provides the solenoid with power when the relay is energized by the PCM/ECM.

Load Engagement Switch — Like

the PTO solenoid, the load engagement switch is an upfitter-installed device. The switch is typically wired into the power feed for the PTO solenoid and must be closed before the PTO will engage.

PTO Module — Introduced for the 2007 model year, the PTO module (PTOM) provides these functions:

- Replaces many of the functions previously performed by the PCM/ECM
- Receives input from the PTO switch
- Controls the PTO relay
- Processes requests to the ECM/PCM and BCM regarding remote starting and engine shutdown
- Shares information and data with the BCM, ECM/PCM, IPC and TCM regarding desired PTO operation
- Processes information from the TCM regarding transmission temperature and gear position
- Requests the IPC to display information and messages regarding PTO operation



Body Control Module (BCM) — The BCM is now part of the PTO system (2007 and later). The BCM stores the PTO configuration; if the factory preset configuration needs to be changed, the BCM will have to be reprogrammed using a scan tool. This includes the default modes of operation.

In addition, the BCM acts as the master controller for many functions, including remote start.

Modes of Operation

Several modes of operation may be available, depending on vehicle application and content. These include:

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Preset Mode/Stationary Mode —

This mode is used for stationary operation. Preset mode provides a default standby speed of 800-850 RPM, and two preset PTO speeds: 1250 RPM and 1700 RPM. Maximum engine speed for PTO operation is typically set at 2200 RPM.

To operate the PTO in preset mode, these conditions must be present:

- Engine running
- Transmission in park or neutral
- Park brake set on manual transmission applications
- VSS 0 MPH
- Foot off the brake or clutch
- PTO switch on

With these conditions met, engine RPM will increase to standby speed. The LED on the PTO switch will flash, indicating the PTO is attempting to engage. Once the LED changes to a steady state, the PTO should be engaged.

Variable Modes — Variable mode can be used for stationary or mobile applications. This mode allows the PTO to be controlled in 100 RPM increments. Variable mode allows the operator to “Tap Up” or “Tap Down” the PTO speed by using the set and resume cruise control switches. Applications not equipped with cruise control won’t have the “Tap” features.

Variable mode can be operated with the vehicle stationary or in motion. If the vehicle is in motion, the system will allow the driver to attain the desired engine RPM (not vehicle speed) for PTO operation.

To operate the PTO in variable mode, these conditions must be present:

- Engine running
- Foot off the brake or clutch
- PTO switch on
- Engine RPM raised to standby speed

From here, you’ll be able to obtain the desired engine RPM by pressing the accelerator pedal. Then press the set button on the PTO switch or cruise control switch to retain the desired set speed.

The LED on the PTO switch will flash when the PTO is attempting to engage. The LED will change to a

steady state when the PTO has engaged. The set and resume buttons can now be used to adjust engine speed in 100 RPM increments.

NOTE: Engine RPM must be greater than PTO standby speed but lower than the maximum PTO engine RPM for the system to function.

NOTE: For the system to function the PCM must be programmed for the variable mode. If the system wasn’t factory equipped (RPO PTO), you’ll need to reprogram the PCM/ECM for PTO function with your scan tool.

Fast Idle Mode — This mode is typically used on vehicles that don’t use a PTO, but have need for a higher-than-normal idle speed when the vehicle is stationary. A typical application for fast idle mode would be an ambulance. As with a PTO system, to make the vehicle operate in fast idle mode, additional equipment is necessary.

On many applications (RPO UF3), an 8-pin PTO connector is located behind passenger air bag switch in the dash. The connector is typically taped to the IP harness. If the connector is present, a GM accessory kit is available to make the fast idle mode installation easier. The accessory kit is available under GM part number 12497678. Some applications may not have the connector, so hard wiring will be required.

Once the kit is installed or the system hardwired, the PCM may need to be programmed to enable fast idle operation. You’ll need to program these factory default parameters into the PCM/ECM with your scan tool:

PTO Max Engine Speed	2200-4400 RPM (Factory default 2200 RPM)
PTO Standby Speed	800-1200 RPM (Factory default 800 RPM)
PTO Set Speed	1250-1400 RPM (Factory default 1250 RPM)
PTO Resume Speed	1700 RPM
PTO Max Engage Speed	1000-1800 RPM (Factory default 1000 RPM)
PTO Shutdown	NO
PTO Engage Relay	NO
PTO Feedback	NO

With the kit installed and the programming complete, the fast idle function should operate. To engage fast idle, these conditions must be met:

- Park range (neutral on M/T)
- Park brake set (M/T)

- Fast idle/PTO switch on
- Press the set button on the cruise control or PTO switch

This should force the engine idle to increase. On some applications, pressing the resume/accelerate button on the cruise control will allow the engine speed to “tap up” while touching the set button will decrease fast idle speed.

Major changes have occurred for the 2007-2009 model year applications. These include:

- Kit 12497678 is no longer required if the vehicle is ordered with RPO PTO.
- A new, dedicated, in-cab multi-function switch is included in the PTO factory package.
- A dedicated upfitter connector now appears on all applications.
- A dedicated PTO module controls PTO operation.
- A remote enable switch provides remote on/off control of the PTO.
- A remote engine start and shutdown feature can be programmed to operate with a scan tool.
- Automatic engine shutdown feature warns the driver by honking the horn prior to shutdown. This feature monitors oil level, oil pressure, coolant level, transmission fluid temperature, fuel level and diesel particulate filter regeneration.
- Tap Up/Tap Down is no longer accomplished using the cruise control switch. The multifunction switch now provides the Tap Up/Tap Down functions for the PTO system.

• New transmission calibrations prevent shift business during mobile PTO operation.

• Remote tachometer and PTO status LEDs allow for easy system monitoring when you’re out of the cab (2009).

Well as you can see, the PTO system is a complex animal. Until next time, remember: “Success doesn’t come to you... you go to it.”



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