

2017 Transmission
Power Take-Off - Sierra, Silverado

SCHEMATIC WIRING DIAGRAMS

POWER TAKE-OFF (PTO) WIRING SCHEMATICS

Power, Ground, Serial Data and Enable

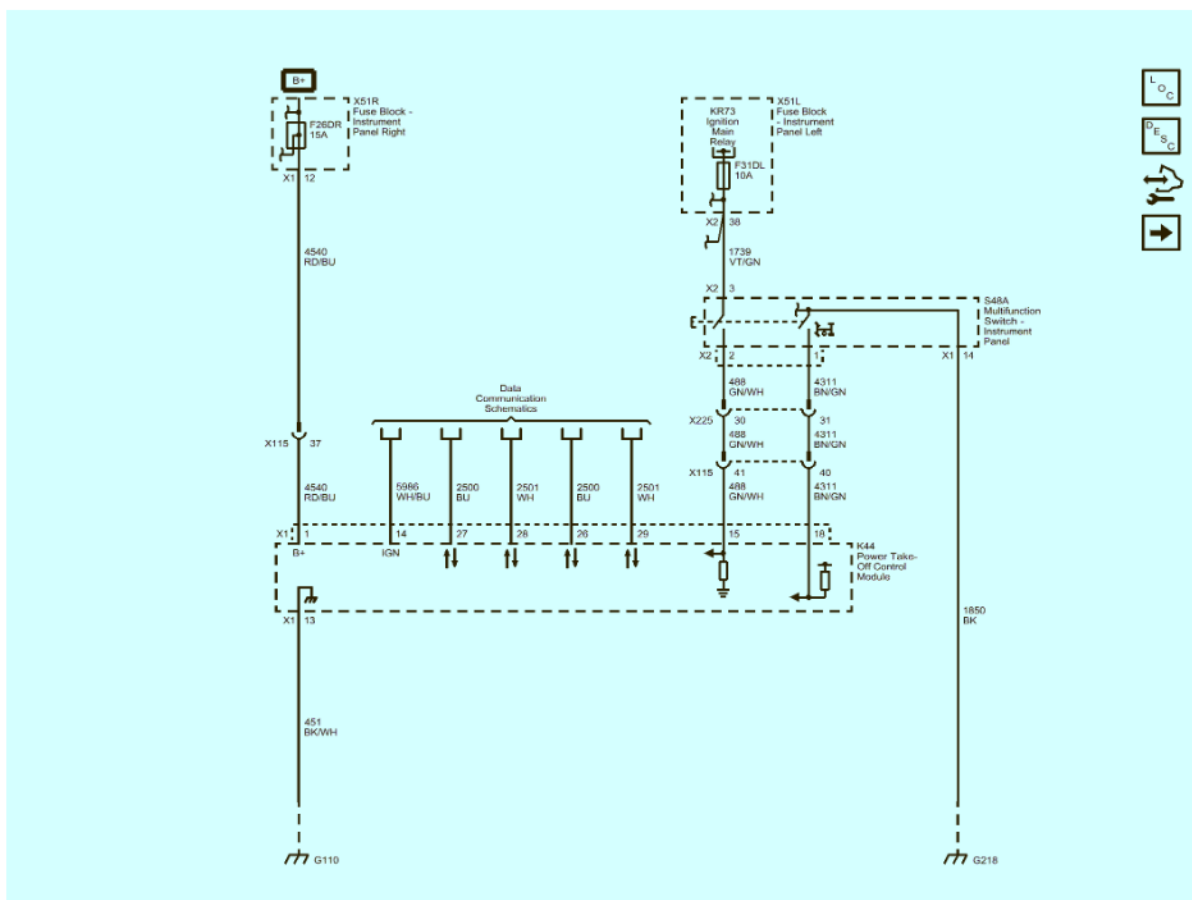


Fig. 1: Power, Ground, Serial Data and Enable
Courtesy of GENERAL MOTORS COMPANY

Provisional Connector

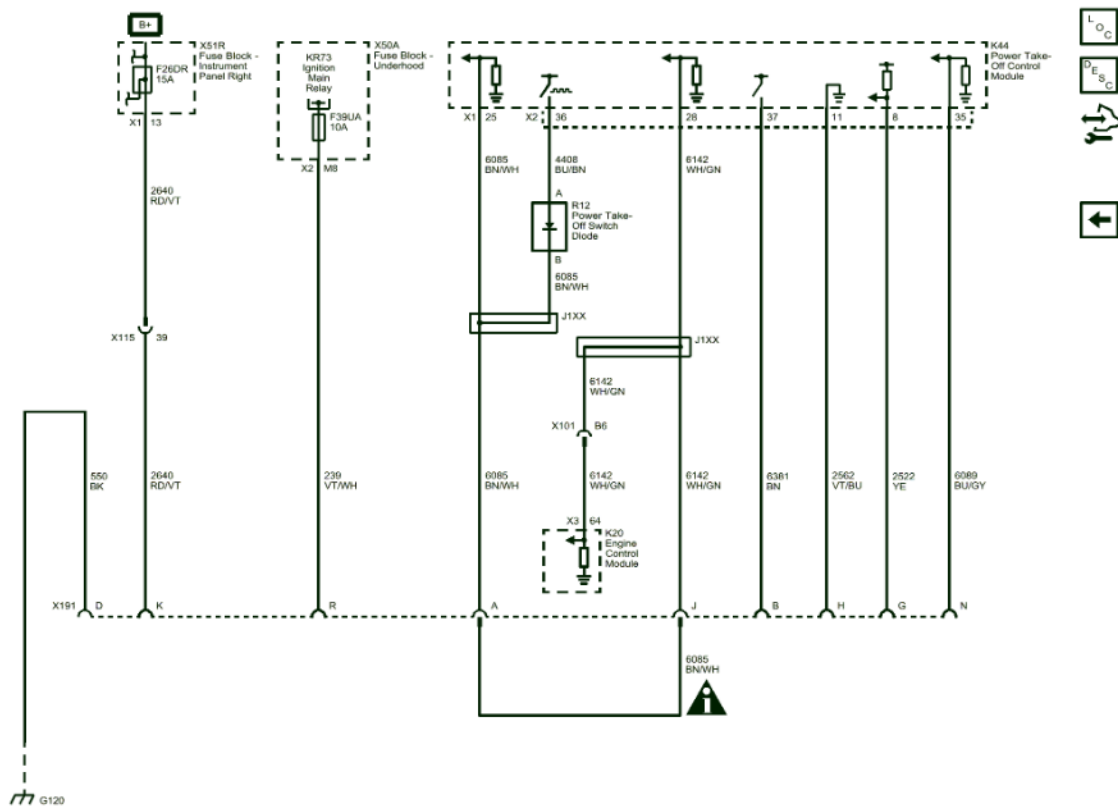


Fig. 2: Provisional Connector

Courtesy of GENERAL MOTORS COMPANY

DIAGNOSTIC INFORMATION AND PROCEDURES

DTC P061C: CONTROL MODULE ENGINE SPEED SYSTEM

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P061C

Control Module Engine Speed System Circuitry Performance

Circuit/System Description

The power take-off (PTO) is an upfitter integrated system that allows the user to create an auxiliary power source. The PTO system specifically controls engine speed to values higher than normal base idle, PTO load relay engagement and remote starting and shutdown of the engine. When the operator requests PTO using either the PTO switch or PTO remote, the engine RPM will increase to a default standby speed. The engine control module (ECM) converts the data from the engine speed sensor to a 2 pulses/engine revolution signal. When PTO is engaged, the power take-off control module sends a serial data message to the ECM requesting engine

speeds, in accordance to signals from the PTO switch or remote.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

- The power take-off control module detects that the requested RPM and the actual engine RPM do not match.
- The above condition is present for greater than a predetermined time threshold.

Actions Taken When the DTC Sets

The power take-off control module stores the DTC information into memory when this diagnostic runs and fails.

Conditions for Clearing the DTC

- A last test failed, or the current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 100 malfunction-free ignition cycles have occurred.

Diagnostic Aids

- When not in mobile PTO mode, heavy engine load may cause this DTC to set.
- Use a scan tool to observe the PTO inhibit and disengage history.

Reference Information

Schematic Reference

Power Take-Off (PTO) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Take-Off (PTO) Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Ignition ON.
2. Verify that no DTCs are set, except DTC P061C.
 - **If any other DTC is set, except DTC P061C**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If only DTC P061C is set**
3. Replace the K44 Power Take-Off Control Module.
4. Verify DTC P061C does not set when operating the vehicle within the conditions for running the DTC.
 - **If the DTC sets**

Replace the K20 Engine Control Module.
 - **If the DTC does not set**
5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for power take-off control module or ECM replacement, programming, and setup.

DTC P158F: POWER TAKE-OFF (PTO) REMOTE ARM SWITCH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P158F

Power Take-Off (PTO) Remote Arm Switch Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
Power Take Off Remote Engine Start Switch Signal	P158F	P158F	P158F	P158F

Circuit/System Description

The power take-off (PTO) is an upfitter integrated system that allows the user to create an auxiliary power source. The PTO system specifically controls engine speed to values higher than normal base idle, PTO load relay engagement, and remote starting and shutdown of the engine. When the operator requests PTO using either the PTO switch or PTO remote, the engine RPM will increase to a default standby speed. The engine control module (ECM) converts the data from the engine speed sensor to a 2 pulses/engine revolution signal. When PTO is engaged, the power take-off control module sends a serial data message to the ECM requesting

engine speeds, in response to signals from the PTO switch or remote.

Conditions for Running the DTC

- Ignition/Vehicle On or the engine is running.
- Battery voltage between 9 V and 16 V.
- This diagnostic runs continuously.

Conditions for Setting the DTC

The power take-off control module detects a remote arm switch stuck in the closed position for greater than 20 s.

Action Taken When the DTC Sets

- The malfunction indicator lamp (MIL) will not illuminate.
- The power take-off control module records the operating conditions at the time the diagnostic fails. The power take-off control module stores this information in the Failure Records.
- The power take-off system will be disabled.

Conditions for Clearing the DTC

- A last test failed, or the current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if failures are not reported by this or any other emission related diagnostic.

Diagnostic Aids

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

Reference Information

Schematic Reference

Power Take-Off (PTO) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Take-Off (PTO) Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

[Control Module References](#) for scan tool information

Circuit/System Testing

NOTE: This diagnostic procedure will only diagnose factory installed components. It will not diagnose upfitter provided equipment. If the cover for the frame rail X191 Provisional connector, which includes a jumper wire, is removed DTC P251E may set.

1. Ignition/Vehicle Off and all vehicle systems Off, disconnect the harness connectors at the K44 Power Take-Off Control Module and remove the frame rail X191 Provisional connector cover. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 1 V between the K44 Power Take-Off Control Module connector X1 terminal 25 and ground.
 - **If 1 V or greater**
Repair the short to voltage on the circuit.
 - **If less than 1 V**
3. Test for infinite resistance between the K44 Power Take-Off Control Module connector X1 terminal 25 and ground.
 - **If less than infinite resistance**
Repair the short to ground on the circuit.
 - **If less than 2 Ω**
4. Test for less than 2 Ω end to end in the K44 Power Take-Off Control Module connector X1 terminal 25 and the frame rail X191 Provisional Connector terminal A.
 - **If 2 Ω or greater**
Repair the open/high resistance in the circuit.
 - **If less than 2 Ω**
5. Test or replace the K44 Power Take-Off Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for control module replacement, programming and setup.

DTC P159C: POWER TAKE-OFF (PTO) REMOTE ENGINE SHUTDOWN SWITCH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P159C

Power Take-Off (PTO) Remote Engine Shutdown Switch Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
Power Take Off Engine Shutdown Signal	P159C	P159C	P159C	-

Circuit/System Description

The power take-off (PTO) is an upfitter integrated system that allows the user to create an auxiliary power source. The PTO system specifically controls engine speed to values higher than normal base idle, PTO load relay engagement, and remote starting and shutdown of the engine. When the operator requests PTO using either the PTO switch or PTO remote, the engine RPM will increase to a default standby speed. The engine control module (ECM) converts the data from the engine speed sensor to a 2 pulses/engine revolution signal. When PTO is engaged, the power take-off control module sends a serial data message to the ECM requesting engine speeds, in response to signals from the PTO switch or remote.

Conditions for Running the DTC

- The vehicle is equipped with Power Take Off (PTO) equipment.
- The Power Take Off Control Module (PTOM) is configured for remote PTO.
- The vehicle is in a stationary condition with the park brake set, transmission in park and the vehicle speed is 0.

Conditions for Setting the DTC

The engine control module detects a fault on the PTO remote engine shutdown switch circuit.

Action Taken When the DTC Sets

- The engine will not start using the remote pendant.
- The engine will shut down if the engine is running and the PTO is in operation.

Conditions for Clearing the DTC

- A last test failed, or the current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if failures are not reported by this or any other emission related diagnostic.

Diagnostic Aids

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

Reference Information

Schematic Reference

Power Take-Off (PTO) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Take-Off (PTO) Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Testing

NOTE: This diagnostic procedure will only diagnose factory installed components. It will not diagnose upfitter provided equipment. If the cover for the frame rail X191 Provisional connector, which includes a jumper wire, is removed DTC P251E may set.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the K44 Power Take-Off Control Module and the K20 Engine Control Module. Remove the frame rail X191 Provisional connector cover. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 1 V between the Power Take Off Engine Shutdown Signal circuit and ground.
 - **If 1 V or greater**
Repair the short to voltage on the circuit.
 - **If less than 1 V**
3. Test for infinite resistance between the Power Take Off Engine Shutdown Signal circuit and ground.
 - **If less than infinite resistance**
Repair the short to ground on the circuit.
 - **If less than 2 Ω**
4. Test for less than 2 Ω end to end at the Power Take Off Engine Shutdown Signal circuit terminals listed below:
 - K20 Engine Control Module connector X1 terminal 25.
 - K44 Power Take-Off Control Module connector X2 terminal 28.
 - **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

5. Test or replace the K20 Engine Control Module.

6. Verify DTC P159C does not set when operating the vehicle within the conditions for running the DTC.

- **If the DTC sets**

Replace the K44 Power Take-Off Control Module.

- **If the DTC does not set**

7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for control module replacement, programming and setup.

DTC P159D: POWER TAKE-OFF (PTO) REMOTE MODE SWITCH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P159D

Power Take-Off (PTO) Remote Mode Switch Circuit

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Power Take Off Remote Switch Set Signal	P159D	P159D	P159D	P159D

Circuit/System Description

The power take-off (PTO) is an upfitter integrated system that allows the user to create an auxiliary power source. The PTO system specifically controls engine speed to values higher than normal base idle, PTO load relay engagement, and remote starting and shutdown of the engine. When the operator requests PTO using either the PTO switch or PTO remote, the engine RPM will increase to a default standby speed. The engine control module (ECM) converts the data from the engine speed sensor to a 2 pulses/engine revolution signal. When PTO is engaged, the power take-off module (PTOM) sends a GMLAN serial data message to the ECM requesting engine speeds, in response to signals from the PTO switch or remote.

Conditions for Running the DTC

The engine is running and PTO is engaged.

Conditions for Setting the DTC

- The power take-off control module detects a signal mismatch between the remote engine shut off signal and the PTO engine shutdown signal.
- The above condition is present continuously for greater than a predetermined time threshold.

Action Taken When the DTC Sets

- The PTOM stores the DTC information into memory when this diagnostic runs and fails.
- The malfunction indicator lamp (MIL) will not illuminate.
- PTO becomes disabled until the next ignition cycle.
- The remote engine start function defaults back to disabled.

Conditions for Clearing the DTC

- A last test failed, or the current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if failure is no longer present.

Reference Information

Schematic Reference

Power Take-Off (PTO) Schematics

Connector End View Reference

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Description and Operation

Power Take-Off (PTO) Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

NOTE: This diagnostic procedure will only diagnose factory installed components. It will not diagnose upfitter provided equipment.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the K44 Power Take-Off Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 1 V between the K44 Power Take-Off Control Module remote switch set signal

connector X2 terminal 35 and ground.

- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

3. Test for infinite resistance between the K44 Power Take-Off Control Module remote switch set signal connector X2 terminal 35 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If less than 2 Ω**

4. Test for less than 2 Ω end to end between the K44 Power Take-Off Control Module remote switch set signal connector X2 terminal 35 and the frame rail X191 Provisional Connector terminal N.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

5. Test or replace the K44 Power Take-Off Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for power take-off control module replacement, programming or setup.

DTC P1598: POWER TAKE OFF (PTO) ENGINE SPEED REQUEST SIGNAL MESSAGE COUNTER

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P1598

Power Take Off (PTO) Engine Speed Request Signal Message Counter Incorrect

Circuit/System Description

The power take-off control module is constantly sending the engine control module serial data messages with information regarding its request for modifying engine speed. The engine control module sets this code when it detects a discrepancy in the structure of this message causing its integrity to be questioned.

Conditions for Running the DTC

- The engine is running.
- This DTC runs continuously.

Conditions for Setting the DTC

The power take-off control module detects a fault in the serial data message between the power take-off control module and the engine control module.

Actions Taken When the DTC Sets

DTC P1598 is a type B DTC.

Conditions for Clearing the DTC

DTC P1598 is a type B DTC.

Reference Information

Schematic Reference

Power Take-Off (PTO) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Take-Off (PTO) Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Ignition ON.
2. Verify that no DTCs are set, except DTC P1598.
 - **If any other DTC is set, except DTC P1598**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If only DTC P1598 is set**
3. Replace the K44 Power Take-Off Control Module.
4. Verify DTC P1598 does not set when operating the vehicle within the Conditions for Running the DTC.
 - **If the DTC sets**

Replace the K20 Engine Control Module.

- If the DTC does not set

5. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

[Control Module References](#) for control module replacement, programming, and setup.

DTC P251A OR P258E: POWER TAKE-OFF (PTO) ENABLE SWITCH

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P251A

Power Take-Off (PTO) Enable Switch Circuit

DTC P258E

Power Take-Off (PTO) Enable Switch Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
Run/Crank Ignition 1 Voltage	P251A	P251A	-	-
Power Take Off Enable Switch	P251A	P251A	P251A	P258E
Power Take Off Enable In Cab Switch Normally Closed Signal	P251A	P251A	P251A	P258E
Ground	-	P251A	-	-

Circuit/System Description

The power take-off (PTO) is an upfitter integrated system that allows the user to create an auxiliary power source. The PTO system specifically controls engine speed to values higher than normal base idle, PTO load relay engagement, and remote starting and shutdown of the engine. When the operator requests PTO using either the PTO switch or PTO remote, the engine RPM will increase to a default standby speed. The engine control module (ECM) converts the data from the engine speed sensor to a 2 pulses/engine revolution signal. When PTO is engaged, the power take-off control module sends a serial data message to the ECM requesting engine speeds, in response to signals from the PTO switch or remote.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

The power take-off control module detects a fault on the PTO enable switch circuit that is above or below a predetermined voltage threshold.

Action Taken When the DTC Sets

- The malfunction indicator lamp (MIL) will not illuminate.
- The power take-off control module records the operating conditions at the time the diagnostic fails. The power take-off control module stores this information in the Failure Records.

Conditions for Clearing the DTC

- A last test failed, or the current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if failures are not reported by this or any other emission related diagnostic.

Diagnostic Aids

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

Reference Information

Schematic Reference

Power Take-Off (PTO) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Take-Off (PTO) Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

NOTE: This diagnostic procedure will only diagnose factory installed components. It will not diagnose upfitter provided equipment.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the S48A Multifunction Switch - Instrument Panel. It may take up to 2 min for all vehicle systems to power down.

2. Test for less than 10 Ω between the S48A Multifunction Switch - Instrument Panel connector X1 ground circuit terminal 14 and ground.
- **If 10 Ω or greater**
 1. Ignition OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Ignition ON.
4. Verify a test lamp illuminates between the S48A Multifunction Switch - Instrument Panel ignition circuit connector X2 terminal 3 and ground.
- **If the test lamp does not illuminate and the circuit fuse is good**
 1. Ignition OFF, remove the test lamp.
 2. Test for less than 2 Ω in the ignition circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is OK and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Ignition OFF, remove the test lamp.
 2. Test for infinite resistance between the ignition circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the S48A Multifunction Switch - Instrument Panel.
 - **If the test lamp illuminates**
5. Test for 12 k Ω - 14 k Ω between the S48A Multifunction Switch - Instrument Panel PTO enable switch signal circuit connector X2 terminal 2 and ground.
- **If less than 12 k Ω**
 1. Disconnect the harness connector at the K44 Power Take-Off Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K44 Power Take-Off Control Module.
 - **If greater than 14 k Ω**
 1. Disconnect the harness connector at the K44 Power Take-Off Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Ignition OFF.
4. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K44 Power Take-Off Control Module.- **If between 12 - 14 k Ω**

6. Ignition ON.

7. Test for 11.8-12.2 V between the S48A Multifunction Switch - Instrument Panel power take off enable

signal circuit connector X2 terminal 1 and ground.

- **If less than 11.8 V**

1. Ignition OFF, disconnect the harness connector at the K44 Power Take-Off Control Module.
2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K44 Power Take-Off Control Module.

- **If greater than for 12.2 V**

1. Ignition OFF, disconnect the harness connector at the K44 Power Take-Off Control Module, ignition ON.
2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K44 Power Take-Off Control Module.

- **If between 11.8-12.2 V**

8. Test for replace the S48A Multifunction Switch - Instrument Panel.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Vehicle Stability Control System Switch Replacement](#) for vehicle stability control system switch replacement.

[Control Module References](#) for power take-off control module replacement, programming and setup.

DTC P251E OR P251F: POWER TAKE-OFF (PTO) ENGINE SHUTDOWN CONTROL

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P251E

Power Take-Off (PTO) Engine Shutdown Control Circuit Low Voltage

DTC P251F

Power Take-Off (PTO) Engine Shutdown Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
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Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
Power Take Off Remote Engine Start Switch Signal	P251A	P251A	P251A	P251A
Power Take Off Engine Shutdown Signal	P251F	P251F	P251F	P251F

Circuit/System Description

The power take-off (PTO) is an upfitter integrated system that allows the user to create an auxiliary power source. The PTO system specifically controls engine speed to values higher than normal base idle, PTO load relay engagement, and remote starting and shutdown of the engine. When the operator requests PTO using either the PTO switch or PTO remote, the engine RPM will increase to a default standby speed. The engine control module (ECM) converts the data from the engine speed sensor to a 2 pulses/engine revolution signal. When PTO is engaged, the power take-off control module sends a serial data message to the ECM requesting engine speeds, in response to signals from the PTO switch or remote.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

The power take-off control module detects a fault on the PTO engine shutdown control circuit that is above or below a predetermined voltage threshold.

Action Taken When the DTC Sets

- The malfunction indicator lamp (MIL) will not illuminate.
- The power take-off control module records the operating conditions at the time the diagnostic fails. The power take-off control module stores this information in the Failure Records.

Conditions for Clearing the DTC

- A last test failed, or the current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if failures are not reported by this or any other emission related diagnostic.

Diagnostic Aids

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

Reference Information

Schematic Reference

Power Take-Off (PTO) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Power Take-Off (PTO) Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

NOTE: This diagnostic procedure will only diagnose factory installed components. It will not diagnose upfitter provided equipment. If the cover for the frame rail X191 Provisional connector, which includes a jumper wire, is removed DTC P251E may set.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the K44 Power Take-Off Control Module and remove the frame rail X191 Provisional connector cover. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 1 V between the engine shutdown control circuit terminals listed below and ground:
 - K44 Power Take-Off Control Module connector X1 terminal 25
 - K44 Power Take-Off Control Module connector X2 terminal 28
 - **If 1 V or greater**

Repair the short to voltage on the circuit.

 - **If less than 1 V**
3. Test for infinite resistance between the engine shutdown control circuit terminals listed below and ground:
 - K44 Power Take-Off Control Module connector X1 terminal 25
 - K44 Power Take-Off Control Module connector X2 terminal 28
 - **If less than infinite resistance**

Repair the short to ground on the circuit.

 - **If less than 2 Ω**
4. Test for less than 2 Ω end to end in the engine shutdown control circuits listed below:
 - K44 Power Take-Off Control Module connector X1 terminal 25 and the frame rail X191 Provisional Connector terminal A
 - K44 Power Take-Off Control Module connector X2 terminal 28 and the frame rail X191 Provisional Connector terminal J
 - **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

5. Test or replace the K44 Power Take-Off Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for power take-off control module replacement, programming and setup.

DTC P253D: POWER TAKE-OFF (PTO) RELAY FEEDBACK

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P253D

Power Take-Off (PTO) Relay Feedback Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
PTO Engage Signal	-	-	P253D	-

Circuit/System Description

The power take-off (PTO) is an upfitter integrated system that allows the user to create an auxiliary power source. The PTO system specifically controls engine speed to values higher than normal base idle, PTO load relay engagement, and remote starting and shutdown of the engine. When the operator requests PTO using either the PTO switch or PTO remote, the engine RPM will increase to a default standby speed. The engine control module (ECM) converts the data from the engine speed sensor to a 2 pulses/engine revolution signal. When PTO is engaged, the power take-off module (PTOM) sends a GMLAN serial data message to the ECM requesting engine speeds, in response to signals from the PTO switch or remote.

Conditions for Running the DTC

The ignition is ON and PTO is engaged.

Conditions for Setting the DTC

- The PTOM detects a high voltage signal at the PTO engage signal circuit.
- The above condition is present continuously for greater than a predetermined time threshold.

Action Taken When the DTC Sets

- The PTOM stores the DTC information into memory when this diagnostic runs and fails.

- The malfunction indicator lamp (MIL) will not illuminate.
- PTO becomes disabled until the next ignition cycle.

Conditions for Clearing the DTC

- A last test failed, or the current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if failure is no longer present.

Reference Information

Schematic Reference

Power Take-Off (PTO) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Take-Off (PTO) Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

Engine ON, press the PTO switch to engage PTO. The engine RPM should increase to the default engine speed within a few seconds. Press RES + to increase the engine speed and SET - to decrease the engine speed accordingly.

Circuit/System Testing

NOTE: This diagnostic procedure will only diagnose factory installed components. It will not diagnose upfitter provided equipment.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connector at the K44 Power Take-Off Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 1 V between the K44 Power Take-Off Control Module status signal connector X2 terminal 8 and ground.
 - If 1 V or greater

Repair the short to voltage on the circuit.

- **If less than 1 V**

3. Test for infinite resistance between the K44 Power Take-Off Control Module status signal connector X2 terminal 8 and ground.

- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If less than 2 Ω**

4. Test for less than 2 Ω end to end between the K44 Power Take-Off Control Module status signal connector X2 terminal 8 and the frame rail X191 Provisional Connector terminal G.

- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

5. Test or replace the K44 Power Take-Off Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[Control Module References](#) for power take-off control module replacement, programming or setup.

DTC P260A-P260C: POWER TAKE-OFF (PTO) RELAY

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P260A

Power Take-Off (PTO) Relay Control Circuit

DTC P260B

Power Take-Off (PTO) Relay Control Circuit Low Voltage

DTC P260C

Power Take-Off (PTO) Relay Control Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
Power Take Off Relay Engage Signal	P260A, P260B	P260B	P260C	P260B

Circuit	Short to Ground	Open or High Resistance	Short to Voltage	Signal Performance
Power Take Off Relay Coil Control	P260A, P260B	P260B	P260C	P260B

Circuit/System Description

The power take-off (PTO) is an upfitter integrated system that allows the user to create an auxiliary power source. The PTO system specifically controls engine speed to values higher than normal base idle, PTO load relay engagement, and remote starting and shutdown of the engine. When the operator requests PTO using either the PTO switch or PTO remote, the engine RPM will increase to a default standby speed. The engine control module (ECM) converts the data from the engine speed sensor to a 2 pulses/engine revolution signal. When PTO is engaged, the power take-off control module sends a serial data message to the ECM requesting engine speeds, in response to signals from the PTO switch or remote.

Conditions for Running the DTC

The engine is running.

Conditions for Setting the DTC

The power take-off control module detects a fault on the PTO relay coil control circuit that is above or below a predetermined voltage threshold.

Action Taken When the DTC Sets

- The malfunction indicator lamp (MIL) will not illuminate.
- The power take-off control module records the operating conditions at the time the diagnostic fails. The power take-off control module stores this information in the Failure Records.

Conditions for Clearing the DTC

- A last test failed, or the current DTC, clears when the diagnostic runs and does not fail.
- A history DTC clears after 40 consecutive warm-up cycles, if failures are not reported by this or any other emission related diagnostic.

Diagnostic Aids

Using the Failure Records data may help locate an intermittent condition. If you cannot duplicate the DTC, the information in the Failure Records can help determine how many miles since the DTC set. The Fail Counter and Pass Counter can help determine how many ignition cycles that the diagnostic test reported a pass and/or a fail.

Reference Information

Schematic Reference

Power Take-Off (PTO) Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Power Take-Off (PTO) Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

NOTE: This diagnostic procedure will only diagnose factory installed components. It will not diagnose upfitter provided equipment.

1. Ignition OFF and all vehicle systems OFF, disconnect the harness connectors at the K44 Power Take-Off Control Module. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 1 V between the relay coil control and the relay engage signal circuit terminals listed below and ground:

- K44 Power Take-Off Control Module signal circuit connector X2 terminal 37
- K44 Power Take-Off Control Module low reference connector X2 terminal 11
- **If 1 V or greater**

Repair the short to voltage on the circuit.

- **If less than 1 V**

3. Test for infinite resistance between the relay coil control and the relay engage signal circuit terminals listed below and ground:

- K44 Power Take-Off Control Module signal circuit connector X2 terminal 37
- K44 Power Take-Off Control Module low reference connector X2 terminal 11
- **If less than infinite resistance**

Repair the short to ground on the circuit.

- **If less than 2 Ω**

4. Test for less than 2 Ω end to end in the signal and low reference circuits listed below:

- K44 Power Take-Off Control Module connector X2 terminal 37 and the frame rail X191 Provisional Connector terminal B
- K44 Power Take-Off Control Module connector X2 terminal 11 and the frame rail X191 Provisional Connector terminal H
- **If 2 Ω or greater**

Repair the open/high resistance in the circuit.

- **If less than 2 Ω**

5. Test or replace the K44 Power Take-Off Control Module.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for power take-off control module replacement, programming and setup.

REPAIR INSTRUCTIONS

ENGINE SPEED POWER TAKE-OFF CONTROL MODULE REPLACEMENT

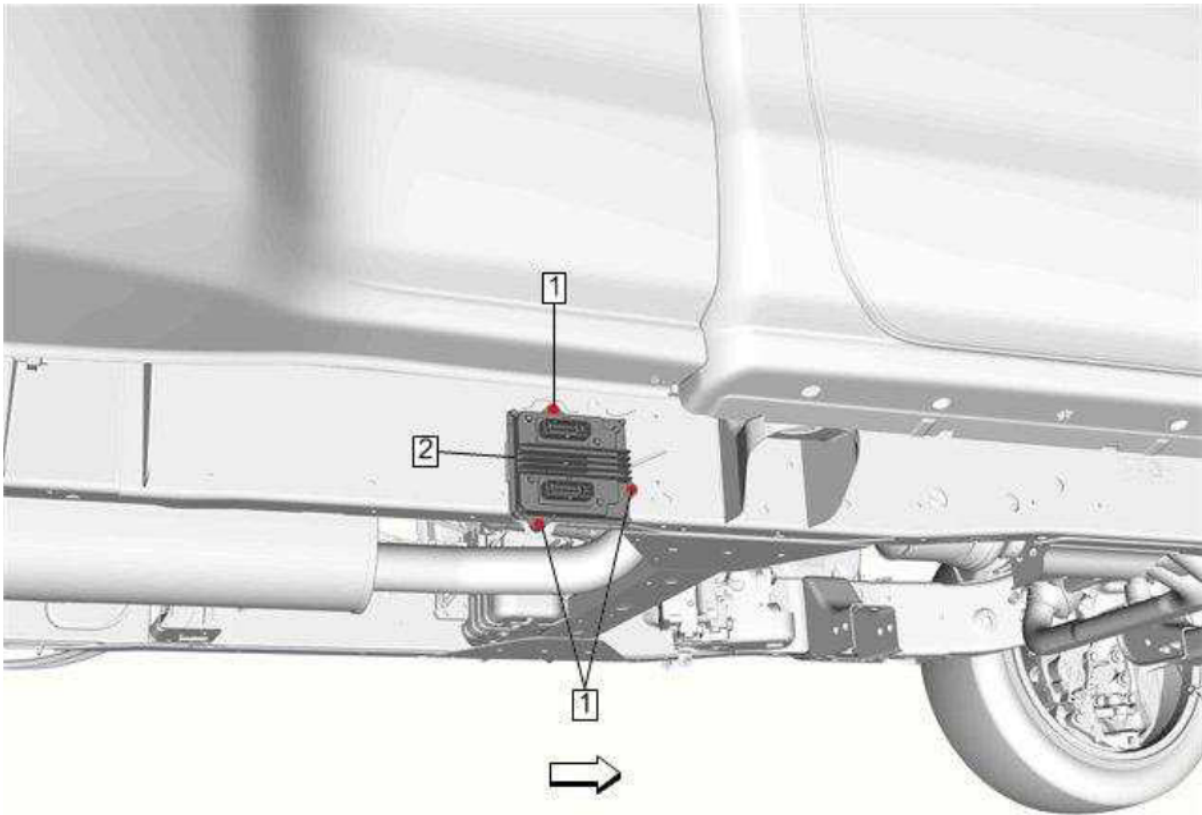


Fig. 3: Auxiliary Chassis Control Module
Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Disconnect the harness connectors.	
1	Engine Speed Power Take-Off Control Module Bolt (Qty: 3) CAUTION: Refer to Fastener Caution . Tighten 9 N.m (80 lb in)

Callout	Component Name
2	Engine Speed Power Take-Off Control Module Procedure New Engine Speed Power Take-Off Control Module must be programmed. Refer to <u>Engine Speed Power Take-Off Control Module Programming and Setup</u>.

DESCRIPTION AND OPERATION

POWER TAKE-OFF (PTO) DESCRIPTION AND OPERATION

The power take-off (PTO) is an upfitter integrated system that allows the user to create an auxiliary power source. The PTO system specifically controls engine speed to values higher than normal base idle, PTO load relay engagement, and remote starting and shutdown of the engine. When the operator requests PTO, the PTO switch will be turned ON and the engine RPM will go to a default standby speed.

The PTO system utilizes the following:

- The transmission driven PTO gear
- The in-cab PTO switch and cruise control SET - and RES + switches
- The PTO telltale indicator
- The power take off module (PTOM)
- The remote PTO upfitter connector

NOTE: For specific information on how to set up and operate the Power Take Off system refer to the vehicle Duramax Diesel supplement manual and the GM Upfitter website.

Factory Installed PTO Components

The in-cab PTO switch and cruise control SET - and RES + switches

The PTO switch is a part of the switch bank and is mounted in the right side of the center instrument panel. The PTO switch is a two position momentary switch with two states: ON/OFF. When the PTO switch is pressed and released to the ON position, the PTO relay will be energized by the PTOM. The cruise control SET - and RES + switches are used to control PTO desired speed. Note that the cruise control ON/OFF switch shall be set to OFF for PTO to operate.

PTO Telltale Indicator

The PTO telltale indicator is a part of the DIC message center. The PTOM shall command the state of the PTO telltale via instrument panel displays based on the following criteria:

- The telltale will illuminate, flashing at a 0.5 second interval rate when the PTO relay is energized. The indicator illuminates solid once the PTO load feedback signal confirms the load has been engaged or after 2 seconds if load feedback is not utilized by the PTO system.
- The telltale will flash at a 1 second interval rate when PTO memory speed is retained. Depressing the in-cab PTO switch to the OFF position turns the PTO system off. The PTO telltale will turn off once engine speed reaches base engine idle, at which time the PTO relay is de-energized.

Power Take-Off Module (PTOM)

- Processes PTO operator switch inputs and translates these inputs into an engine speed request to the ECM
- Controls the engagement of the PTO load relay
- Process requests to the BCM and ECM to start and shutdown the engine
- Requests the IPC to display on the DIC the actions the driver must take to enable PTO
- Requests the ECM to command an engine shutdown and engine shutdown horn warning for critical engine and transition conditions (stationary remote PTO only).

The PTOM constantly looks at the information from various sensors and other inputs, and controls the systems that affect vehicle performance. If any of the PTO engage conditions for the specific operating mode are no longer valid, the engine controller will exit out of PTO mode.

Remote PTO Upfitter Connector

The PTO upfitter connector provides access to all remote PTO functions. The connector is located on the right-hand outside frame rail, underneath the passenger side door. Electrical connections to the following components are provided by this connector. The upfitter connector pin circuits (other than battery, ignition and ground) are disabled as the vehicle is received from the factory. The PTO module must be reprogrammed by the upfitter or dealer to enable the following circuits:

- PTO remote engine arm
- PTO remote engine shutdown/start
- PTO remote set/variable speed potentiometer
- PTO lead feedback

Other Vehicle Modules

The PTO system also utilizes the following vehicle modules, which communicate over the serial data system:

- The body control module (BCM)
- The engine control module (ECM)
- The instrument panel cluster (IPC)
- The transmission control module (TCM)
- The electronic brake control module (EBCM)

Body Control Module (BCM)

The BCM maintains the PTO factory default mode, unless it is reprogrammed with a scan tool to change the PTO configuration mode. The BCM also controls the remote start/shutdown function.

Engine Control Module (ECM)

The ECM controls the engine speed and the engine starting based on messages from the PTOM through serial data. The ECM also provides PTO specific engine information to the PTOM through serial data messages.

Electronic Brake Control Module

The EBCM monitors the vehicle speed. The PTOM receives the status of the vehicle speed from the EBCM via serial data messages.

Instrument Panel Cluster (IPC)

The driver information center (DIC) of the IPC displays actions the driver must take in order to engage PTO. If the PTO will not engage, one or more of the following DIC messages may appear on the instrument panel cluster (IPC):

Stationary PTO	Mobile PTO
PTO: REDUCE VEHICLE SPEED	PTO: DISENGAGE CRUISE CONTROL
PTO: RELEASE BRAKE	PTO: REDUCE ENGINE SPEED
PTO: SET PARK BRAKE	PTO: RELEASE BRAKE
PTO: REDUCE ENGINE SPEED	PTO: PRESS and RELEASE BRAKE
PTO: SHIFT TO P OR N	PTO: REDUCE VEHICLE SPEED
PTO: DISENGAGE CRUISE CONTROL	-

Transmission Control Module (TCM)

The TCM adjusts shift patterns to minimize shifting during PTO operation. The TCM also provides transmission gear states and temperature conditions to the PTOM via serial data messages.

Electronic Brake Control Module (EBCM)

The EBCM disables the PTO if wheel speed pulses are larger than calibratable values. The EBCM also disengages the PTO during a traction control event.

PTO Enable Conditions

Stationary PTO

The following conditions must be met in order to engage stationary PTO:

- The engine must be running.
- The vehicle cannot be moving and the parking brake must be set.
- The shift lever must be in PARK (P) or NEUTRAL (N).
- The brake pedal must not be pressed.
- Cruise control must be OFF.

In-cab PTO operation: Press and release the in-cab PTO switch to the ON position. The PTO telltale indicator will flash fast until the PTO load becomes engaged. When the load becomes engaged, the telltale indicator will stop flashing and stay illuminated. The cruise control SET - and RES + switch positions can then be used to establish the desired PTO operating speed.

Remote PTO operation: Press and release the PTO remote arm switch, then within five seconds, press and release the PTO remote engine start/shutdown switch. The remote PTO indicator light will illuminate when the PTO load is engaged. The PTO remote SET or PTO remote variable speed switches can then be used to establish the desired PTO operating speed. These switches are accessed through the PTO upfitter connector, located under the passenger side door.

Mobile PTO

The following conditions must be met prior to engaging mobile PTO:

- The engine must be running.
- The vehicle speed must be less than the PTO top vehicle speed limit. The default setting is 94 km/h (58 mph). This limit can be adjusted.
- The shift lever must be in M1, M2 or M3.
- The brake must be pressed and then released. The brake must then remain released.
- Cruise control must be OFF.
- Engine speed must be less than the maximum allowed PTO engage speed of 1500 RPM.

Press and release the PTO in-cab switch to the ON position. The PTO telltale will flash fast until the PTO load becomes engaged. When the load becomes engaged, the telltale will stop flashing and stay illuminated. The SET - and RES + switches can then be used to establish the desired PTO operating speed.

PTO Disengage Conditions

Stationary PTO

The stationary PTO mode will disengage if any of the following conditions are detected by the vehicle modules:

- Vehicle movement
- The park brake is released
- The transmission is shifted from PARK (P) to DRIVE (D) or REVERSE (R).
- The PTO load becomes disengaged
- A press and release of the PTO in-cab switch to the OFF position.
- A press and release of the PTO remote engine start/shutdown switch (stationary remote PTO only).
- A press and release of the PTO E-STOP switch (stationary remote PTO only).

Mobile PTO

The mobile PTO mode will also disengage if the following conditions are detected by the vehicle modules:

- A press of the brake pedal
- Vehicle speed exceeds 94 km/h (58 mph)
- Engine speed exceeds the maximum allowed PTO operating speed of 2100 RPM
- The PTO load becomes disengaged
- A press and release of the PTO in-cab switch to the OFF position

The PTO control system will attempt to limit accelerator pedal and PTO switch input as the vehicle approaches the above operational limits. There are some vehicle conditions, such as down hill acceleration, which may cause vehicle speed or engine speed limits to be exceeded. Under those conditions, PTO is disengaged.

Modes of Operation

Preset PTO Mode

Preset PTO can only be used when the vehicle is not moving. The engine speed is initially set to a standby engine speed of 900 RPM. This provides an initial start-up engine speed to match the engagement of the PTO load. The PTO standby engine speed can be reprogrammed to higher speeds.

Choose one of two presets by pressing and releasing the cruise control SET - /RES + or PTO remote set

switches:

- Speed 1: Pressing the cruise control SET - or PTO Remote Set 1 switch results in a preset speed of 1200 RPM.
- Speed 2: Pressing the cruise control RES + or PTO Remote Set 2 switch results in a preset speed of 1900 RPM

Pressing and releasing the PTO in-cab switch or PTO remote engine start/shutdown switch to the OFF position results in the return of the engine speed back to normal idle. The PTO load relay is also disengaged.

Maximum PTO Operating Speed: To protect the PTO from overspeed, the PTO system will disengage when the engine speed exceeds 3100 RPM.

The Stationary PTO Mode provides both in-cab and remote controls. The in-cab controls are enabled as the factory preset. The remote controls are disabled. This factory preset configuration can be reprogrammed to enable the remote controls, and disable the in-cab PTO controls.

NOTE: DO NOT enable/activate PTO during service (hoist) conditions at any time

Variable PTO Mode

In this mode, the vehicle can be programmed for stationary or mobile operation.

The variable PTO mode controls engine speed and PTO load engagement and is selected by either the PTO in-cab or remote switches. Engine speed selection is variable between base engine idle speed and a maximum of 3100 RPM.

In the mobile PTO mode, the vehicle will operate at a vehicle speed resulting from the current PTO engine speed request and current transmission gear range selected.

Vehicle speed stability is greatly improved by shifting into the transmission manual mode because upshifts are limited. This reduces the maximum vehicle speed while allowing high engine speed operation. Therefore, low vehicle speed operation, 16-40 km/h (10-25 mph) and high PTO engine speed 1500-2000 RPM can be achieved in the manual mode 1 and 2 transmission ranges.

In-cab PTO Switch Operation:

- ON: Press and release the PTO in-cab switch to the ON position to engage PTO. The PTOM will increase the engine speed to the factory preset engine speed. The initial standby speed can be adjusted by holding the accelerator to the desired engine speed, then pressing and releasing the ON switch. The current engine speed will become the new standby speed. This adjustment can only be done once at the initial engagement of the PTO, and the initial standby speed adjustment must be between the engine base idle speed and the maximum PTO engine speed.
- OFF: Press and release the PTO in-cab switch to the OFF position to disengage PTO. The engine speed will return to the base idle speed and the PTO load relay will be disengaged.

Cruise Control SET- and RES+ Switch Operation:

- SET -: Press and hold the accelerator to obtain the desired engine speed, then press and release the SET - switch. The current engine speed will be maintained. This action can be repeated as desired to a higher RPM value. The PTO set speed cannot exceed 3100 RPM.
 - Tap Down: Press and release the SET - switch to reduce the engine speed by increments of 100

RPM.

- Coast: Press and hold the SET - switch to reduce the RPM by 150 RPM per second until the desired engine speed is reached or until the initial PTO standby speed is reached.
- RES +: When a PTO set speed has been achieved, press and release the brake pedal. Engine speed will return to normal idle speed. The PTO telltale will flash slowly indicating the previous PTO set speed has been retained in memory. Press and release the RES + to resume the previous PTO set speed. The PTO set speed cannot exceed 3100 RPM.
 - Tap Up: Press and release the RES + to increase the engine speed by increments of 100 RPM.
 - Accelerate: Press and hold the RES + to increase the RPM by 150 RPM per second until the desired engine speed is reached or until the maximum allowable PTO set speed is reached.

PTO State	Applied Switch	Short Apply	Long Apply
PTO STANDBY ENABLED	RES +	Tap Up (Engaged)	Accelerate (Engaged)
PTO STANDBY ENABLED	SET -	Engaged	Engaged
PTO ENGAGED (RPM already higher than standby)	SET -	Tap Down	Coast
PTO ENGAGED (RPM already lower than maximum speed)	RES +	Tap Up	Accelerate
STANDBY DISABLED with no memory speed	RES +	No Action	No Action
STANDBY DISABLED with a memory speed	RES +	Resume	Resume
STANDBY ENABLED with no memory speed	RES +	Tap Up (Engaged)	Resume
STANDBY ENABLED with a memory speed	RES +	Resume	Resume

Remote Engine Start Control

The PTO system allows the engine to be remotely started while operating in the stationary PTO mode. The wiring system provides for connections to a remote engine start arming switch and remote start/shutdown switch. These connections are accessed through the upfitter connector.

The remote start function is initiated by a sequence of switch actions, in addition to several vehicle conditions. The following conditions must be met before attempting to remote start the engine. The vehicle ignition key can be in any position or removed from the ignition:

- The vehicle must be configured for stationary PTO operation.
- The parking brake must be set.
- The transmission must be in PARK (P).
- The hood must be closed.

Once the above conditions are met, to continue with the remote start, use the remote PTO controls to do the following:

1. Press and release the PTO remote arm switch.
2. Within five seconds of releasing the PTO remote arm switch, press and release the PTO remote engine start/shutdown switch until the engine starts.

The PTO system will then elevate engine RPM to standby speed and engage the PTO load. Use the PTO remote set or PTO remote variable speed switches (based on configuration) to elevate PTO speed to the desired engine operating speed.

Remote Engine Shutdown Control

The PTO system allows for remote engine shutdown while operating in the stationary PTO mode. This feature has the following functions:

- Engine shutdown using the operator remote switch: The vehicle wiring system provides remote engine shutdown switch connections, which can be accessed through the PTO upfitter connector.
- Timed auto-engine shutdown: The timed auto-engine shutdown feature provides the means to shut down the engine automatically after a predefined time. PTO must be operational for this function to be active.
- Engine shutdown based on critical engine conditions: The engine can be shutdown when PTO is operating if a critical engine condition is detected by the vehicle system (i.e., low oil, low oil pressure, hot engine, hot transmission, low fuel).
- Emergency engine shutdown: The vehicle wiring system supports remote Emergency engine shutdown via application of the E-STOP switch located at the external (upfitter's) panel accessible through the PTO upfitter connector. (e.g. when PTO relay is stuck closed in Stationary Remote mode, operator shall activate E-STOP switch to shutdown engine and allow engine to be restarted at the next ignition cycle without PTO system activation.

PTO Factory Default Settings

Function	Value/Default Setting	Scan Tool/HMI Customization Menu
PTO Option	None Preset (Default) Variable Mobile	Scan Tool
PTO In-Cab Control	Enabled Disabled	Scan Tool
PTO Remote Control Status	Enabled Disabled (Default)	Scan Tool
PTO Ramp Rate	4 - 150 RPM/sec	Scan Tool
PTO Set 1 Speed	500 - 3100 RPM 1200 RPM (default)	HMI Customization Display/Scan Tool
PTO Set 2 Speed	500 - 3100 RPM 1900 RPM (default)	HMI Customization Display/Scan Tool
PTO Relay	Yes (default) No	Scan Tool
PTO Feedback	Yes (default) No	Scan Tool
Fuel Level for Engine Shutdown	0 - 25% fuel level 15% fuel level	Scan Tool
PTO to Set 1 Speed	Yes No (default)	Scan Tool
PTO Remote Engine Start	Yes No (default)	Scan Tool

Function	Value/Default Setting	Scan Tool/HMI Customization Menu
PTO Remote Set Switch	Yes No (default)	Scan Tool
PTO Remote Set Switch Type	Momentary (default) Latching	Scan Tool
PTO Remote Engine Shutdown	Yes No (default)	Scan Tool
Remote Set Switch Low = (less than 33% of Ignition voltage)	PTO Standby Set 1 (default) Set 2	Scan Tool
Remote Set Switch High + (33% to 66% of Ignition voltage)	PTO Standby Set 1 Set 2 (default)	Scan Tool
Remote Set Switch Open = (greater than 66% ignition voltage)	PTO Standby Set 1 (default) Set 2	Scan Tool
PTO Maximum Engage Speed	0 - 1500 RPM 1500 RPM (default)	Scan Tool
PTO Maximum Engine Speed	500 - 3100 RPM 2100 RPM (default)	Scan Tool
PTO Standby Speed	500 - 1500 RPM 900 RPM (default)	HMI Customization Display/Scan Tool
Engine Run Timer	0 - 1320 minutes	HMI Customization Display/Scan Tool
Chirp Before Start	Enabled (default) Disabled	Scan Tool
PTO Tap Step	4 - 500 RPM/Step 100 RPM/Step (default)	HMI Customization Display/Scan Tool
Brake Release Action	Standby Idle Speed (default)	Scan Tool
Remote PTO Variable Speed Switch	Yes No (default)	Scan Tool
PTO ON During Braking	Yes (default) No	Scan Tool
Maximum Vehicle Speed	30 kph (19 mph) to 94 kph (58 mph) 94 kph ((58 mph) (default)	Scan Tool
PTO Minimum Remote Variable Speed	0 - 50% 2% (default)	Scan Tool
PTO Maximum Remote Variable Speed	50 - 100% 95% (default)	Scan Tool
Engine Shutdown Enable	Yes No (default)	Scan Tool
PTO Accelerator Lockout	Enabled Disabled (default)	Scan Tool

Reprogramming the PTOM for Fast Idle/PTO Using the Scan Tool

A scan tool must be used to enable certain PTO options and also to adjust the factory preset parameters to the desired settings.

For additional scan tool information, refer to [Control Module References](#).

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