Section 55
Chapter 7

PTO CONTROLLER
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PTO CONTROLLER CONFIGURATION

General Information

NOTE: The standard instrumentation and armrest controllers must be calibrated before the PTO controller can be configured.

The PTO controller configuration is performed through the programmable display on the standard instrumentation.

PTO Main Menu

NOTE: Controller programming can only be entered within the first 10 seconds of turning the key switch to the on or run position.

STEP 1

Turn the key switch to the on position. Push the PROG key and hold for two seconds within the first ten seconds of turning on the key switch. A short beep will indicate that the program mode has been accessed and the display will read INST SET MENU.

STEP 2

Press the INCR key until the display reads PTO SET MENU. Press the PROG key.

There are three operations under the main PTO menu.

1. PTO SPEED - Selects either a one or two speed PTO.
2. B LAMPS - Allows the brake lamp relay controller to be used by the PTO.
3. VIEW - Allows the operator to view PTO software version and the ratio between the engine speed and the PTO shaft speed.
4. EXIT - Returns to the main menu.

The INCR and DECR keys are used to toggle between these menus.
PTO Speed Menu

STEP 3
The display will read PTO SPEED. Press the PROG key again. Use the INCR or DECR key to toggle between 1 and 2 and choose the number that applies to the number of PTO speeds that the tractor has.

STEP 4
Press the PROG key to record your choice. The display will read PTO SPEED. Press the DECR key to go to the brake lamp menu.

Brake Lamp Menu

NOTE: This menu will function only on tractors equipped with brake lamps.

STEP 5
The display will read B LAMPS. Press the PROG key.

STEP 6
The display will read YES or NO. Use the INCR or DECR key to toggle between the two. To activate the brake lamps, use yes. If there are no brake lamps, use no. Press the PROG key to save your choice. The display will read B LAMPS.
**View Menu**

**STEP 7**

Press the DECR key. The menu will read PTO VIEW.

Press the PROG key. The display will read SW 1. This is the first part of the software version number.

**STEP 8**

Press the PROG key. The display will read SW 2. This is the second part of the software version number.

**STEP 9**

Press the PROG key. The display will read PTO VIEW. Press the DECR key and the display will read EXIT. Pressing the PROG key will exit from PTO configuration.
Controllers can be checked for fault codes at any time, unless in the calibration mode. Up to 10 fault codes can be stored in each controller.

**STEP 10**

With the key switch in the ON or RUN position, press and hold the DIAG key on the programmable display key board to enter the controller selection screen. The display will read INST DIAG MENU.

**STEP 11**

Use the DECR key to scroll through the different controllers: INST (standard instrumentation) - ENG (engine) - TRANS (transmission) - ARM (armrest) - HITCH - AUX (remote hydraulics) - PTO (power take off) - PERF (performance monitor).

**STEP 12**

When the required controller is displayed, press the PROG key. If a controller is selected that is not on the Data Bus (does not exist), the display will read COMM ERR.

**STEP 13**

Use the INCR and DECR keys to scroll through the 10 possible fault codes. The controller name will be at the top of the display. The fault code and which number that fault is (01 to 10), will be at the bottom of the display.
STEP 14

To erase the fault codes from a controller, press and hold both the INCR and DECR keys for 10 seconds.

NOTE: All the fault codes for that controller will be erased.

STEP 15

When the fault codes are erased, the display will return to the main screen for that controller.

STEP 16

Another controller can be selected at this time by using the INCR and DECR keys to scroll through the controller list as in Step 14.

STEP 17

To exit the select controller screen, scroll until EXIT is displayed and press the PROG key. This will return you to normal operation.
SYMPTOM BASED FAULTS - NO FAULT CODES

"PTO OFF LINE" Appears On Display

Meaning:
The instrumentation (INST), armrest (ARM) and remote (AUX) controllers monitor the data bus status of the PTO controller. If the PTO controller loses power or stops sending information over the data bus "PTO OFF LINE" will appear on the display.

Possible failure mode:
1. Fuse 38 failed.
2. The PTO controller is disconnected (unplugged).
3. Check wire harness routing of the controllers and installed against the cab (make sure wire is not loose or draped in front of the controllers).
4. Pin C056-2 -- Shorted to ground. Provides power to the PTO controller when the right brake is depressed (causes fuse 38 to fail).
5. Pin C056-3 -- Shorted to ground. Provides power to the PTO controller when left brake is depressed (causes fuse 38 to fail).
6. Pin C057-1 -- Power supply to the PTO controllers failed open (fuse 38 is OK) or shorted to ground (causes fuse 38 to fail).
7. Pin C057-4 -- Power supply to the PTO solenoid shorted to ground (fuse 38 fails when PTO is turned ON).
8. Pin C057-12 -- PTO controller ground supply -- If failed open OK as long as controller is bolted to tractor but it should have good ground supply.
9. Pin C056-7 data bus wire (high) is failed open.
10. Pin C056-8 data bus wire (low) is failed open.
11. Poor ground to PTO controller.
12. Connector C010 has a loose or pushed out pin.
13. PTO controller is failed.

Wiring information:

NOTE: Always inspect connector ends for damaged or bent or dislocated pins when troubleshooting.

C056-2 <-> C011-C <-> C163-B (right brake switch) <-> C163-A <-> splice <-> Fuse 38
C056-3 <-> C010-10 <-> C162-A (left brake switch) <-> C162-B <-> splice
C057-1 <-> C010-15 <-> Fuse 38
C057-4 <-> C159-A (PTO solenoid) C159-B <-> C057-5 (PTO solenoid return)
C057-12 <-> Clean ground
C056-7 <-> Data Bus high
C056-8 <-> Data Bus low

IMPORTANT: To avoid pin and harness damage use test leads when taking measurement.

Corrective action:

STEP 1 - Check fuse 38
Check fuse 38.
-- OK - Go to Step 5.
-- NOT OK - Fuse 38 blows, go to Step 2.

STEP 2 - Replace fuse 38
Turn key off.
Replace fuse 38.
Turn key on.
-- OK - Fuse 38 does not fail, go to Step 4.
-- NOT OK - Fuse 38 fails when key is turned on, go to Step 3.
STEP 3 - Check to following circuits
Power supply to the right brake pedal switch is shorted to chassis ground, or right brake switch is shorted.
Power supply to the left brake pedal switch is shorted to chassis ground, or left brake switch is shorted.
Pin C057-1 -- Power supply to the PTO controller is shorted to chassis ground.

STEP 4 - Engage other circuits
Do the following while watching fuse 38 with the key ON.
Depress the right brake pedal.
Depress the left brake pedal.
Turn the PTO switch in the armrest ON.
-- OK - Fuse 38 did not fail, go to Step 5.
-- NOT OK - Fuse 38 failed when right brake pedal was depressed -- circuit between right brake pedal and PTO controller shorted to ground.
-- NOT OK - Fuse 38 failed when left brake pedal was depressed -- circuit between left brake pedal and PTO controller shorted to ground.
-- NOT OK - Fuse 38 failed when PTO switch was turned on -- Pin C057-4 -- Power supply to the PTO solenoid shorted to ground.

STEP 5 - Check PTO controller LED lamp
Remove the controller cover from the rear of the tractor.
Check that the wire harness routing of the controllers is installed against the cab (make sure wire is not loose or draped in front of controllers).
Turn the key ON.
Check the PTO controller LED lamp.
-- OK - LED lamp on PTO controller is flashing OFF and ON, go to Step 7.
-- NOT OK - LED lamp on PTO controller is ON STEADY, replace PTO controller.
-- NOT OK - LED lamp on PTO controller is not on, go to Step 6.

STEP 6 - Check the power and ground supply
Disconnect the black C057 connector from the PTO controller.
Turn the key ON.
Check pin C057-1 for 12 volts.
Check pin C057-12 for ground.
-- OK - Good power and ground supply, connect connector C057 to PTO controller and check lamp.
-- NOT OK - Troubleshoot failed circuit.

STEP 7 - Check data bus
Check Data Bus high - Pin C056-7 data bus wire for open circuit.
Check Data Bus low - Pin C056-8 data bus wire for open circuit.
PTO Will Not Engage -- "TURN PTO OFF" Is On Display

Meaning:
The PTO will not turn when PTO switch is placed in the ON position and no fault codes are recorded.

Possible failure mode:
1. PTO controller is not reading engine RPM at PIN C056-1 (Gray) from the alternator.
2. The 12 volt power supply wire or the PTO solenoid failed OPEN (Pin C057-4 Black connector).
3. Problem with PTO solenoid circuit.

Background:
The PTO controller looks at engine speed from the alternator and PTO output shaft speed before and after the PTO switch is turned on. The PTO controller will engage the PTO solenoid just enough to start shaft rotation. Once shaft rotation is detected the PTO controller will control clutch modulation and run up speed for several seconds before full clutch pressure is applied. If the PTO controller fails to receive information from the PTO solenoid circuit, alternator (engine RPM) or output shaft speed sensor, the PTO will not engage.

Tractors with an engine controller
-- The engine controller will provide engine RPM to the display when the alternator fails but not to the PTO controller, therefore the PTO will not engage when the PTO is turned on if the alternator fails.
-- If the PTO solenoid circuit is failed open, no fault code is recorded.
-- Problem with PTO solenoid.

Tractors without an engine controller
-- The alternator provides engine RPM to the display and to the PTO controller. The transmission controller uses data bus information from the instrumentation controller. When the alternator fails the PTO and the transmission will not engage. Engine RPM will not be displayed on the instrumentation display.
-- If the PTO solenoid circuit is failed open no fault code is recorded.
-- Problem with PTO solenoid.

PTO solenoid resistance
PTO solenoid 6.0 - 6.8 ohms at 25 C (70 F).

Wiring information:
NOTE: Always inspect connector ends for damaged or bent of dislocated pins when troubleshooting.
C057-5 --> C159-B (PTO solenoid) C159-A --> C057-4
Alternator (W) --> C085 --> C333-P --> Splice--> C060-W -->C061-9 (instrument cluster)

Corrective action:

STEP 1 - Alternator check
Clear all fault codes.
Start the tractor and check the display for engine RPM (Tractors without a engine controller).
Turn PTO ON and then OFF.
Check for PTO fault codes.
-- NOT OK - PTO did not turn and PTO fault code 54261 is recorded, go to Step 3 (Tractor with engine controller).
-- NOT OK - No engine RPM read on display, Go to Step 2 (Tractors with no engine controller).
-- NOT OK - No PTO fault codes and PTO will not turn, Go to Step 3.
-- NOT OK - A new PTO fault code was record, go to new fault code for corrective action.

STEP 2 - Check the alternator
Check alternator output at terminal 'W'.
-- OK - Go to Step 3.
-- NOT OK - Replace alternator.
STEP 3 - Check wiring
Remove the controller cover from the rear of the tractor.
Check the wire and connections between the alternator terminal “W” and the PTO controller pin C056-1 for an open circuit.

NOTE: A test wire can be run from the alternator terminal “W” to the PTO controller pin C056-1.

STEP 4 - Check PTO solenoid circuit
Disconnect Connector C057
Measure the resistance between pin C057-5 and C057-4.
-- OK - Resistance measured was between 6.0 and 6.8 ohms at 25 C (100 F).
-- NOT OK - The resistance was not between 6.0 to 6.8 ohms, go to Step 5.

STEP 5 - Test solenoid
Disconnect PTO solenoid at connect C0159.
Measure the resistance of the PTO solenoid.
Inspect connector pins.
-- OK - Replace damaged wire.
-- NOT OK - Replace PTO solenoid.
PTO Has No Modulation When Turned On

Meaning:
The wire from the PTO controller PIN C057-5 to the PTO solenoid is shorted to ground or the PTO solenoid is shorted.

Possible failure mode:
1. The wire from the PTO controller pin C057-5 to the PTO solenoid is shorted to ground.
2. The PTO solenoid is shorted.

Background:
The PTO controller looks at engine speed from the alternator and PTO output shaft speed before and after the PTO switch is turned on. The PTO controller control will engage the PTO solenoid just enough to start shaft rotation. Once shaft rotation is detected the PTO controller will control clutch modulation and ramp up speed for several seconds before full clutch pressure is applied. If the wire between the PTO controller and the PTO solenoid is shorted to chassis ground, the PTO controller can no longer provide modulation to the PTO solenoid and clutch.

PTO solenoid resistance
PTO solenoid 6.0 - 6.8 ohms at 25 C (70 F).

Wiring information:
C057-5 --> C159-B (PTO solenoid) C159-A --> C057-4

Corrective action:

STEP 1 - Check PTO solenoid circuit
Disconnect connector C057.
Measure the resistance between pin C057-5 and C057-4.
-- OK - Resistance measured was between 6.0 and 6.8 ohms (at 100 F)
-- NOT OK - The resistance was not between 6.0 to 6.8 ohms, go to Step 2.

STEP 2 - Test solenoid
Disconnect PTO solenoid at connect C0159.
Measure the resistance of the PTO solenoid.
Inspect connector pins.
-- OK - Replace damaged wire.
-- NOT OK - Replace PTO solenoid.
The Differential Lock Has Problems

Meaning:
The wire from the right hand or left hand brake switch is failed open, shorted to power or the PTO controller is failed.

Possible failure mode:
1. Left or right hand brake switch sticking or failed.
2. Diff Lock solenoid mechanically stuck on or off. (OK electrically)
3. The wire from the right hand or left hand brake switch is failed open or shorted to power.
4. PTO controller failed.

Background:
The PTO controller monitors the differential switch position in the armrest and will energize the Diff lock solenoid when the switch is turned on provided a brake pedal is not depressed. The brake pedal switches assure that the Diff lock is turned off when it makes tight turns with the brake. The brake pedal switches provide power to the PTO controller pins 2 and 3 of connector C056.

-- The Diff lock drive in the PTO controller can be damaged if the wire to pin C057-9 is shorted to power when the key is off.

The right brake switch supplies a 12 volt signal to controller pin C056-02 when right brake pedal is depressed.
-- If the switch fails or the wire from the switch is shorted to power -- No fault codes -- Diff lock will not engage.
-- If shorted to ground -- PTO OFF LINE -- Fuse 38 blows.
-- If circuit is failed open -- No fault codes -- Diff lock will not disengage when left brake pedal is depressed. Depressing the right brake pedal will turn off the DIFF.

The left brake switch supplies a 12 volt signal to the controller pin C056-03 when left brake pedal is depressed.
-- If the switch fails or the wire from the switch is shorted to power -- No fault codes -- Diff lock will not engage.
-- If shorted to ground -- PTO OFF LINE -- Fuse 38 blows.
-- If circuit is failed open -- No fault codes -- Diff lock will not disengage when right brake pedal is depressed. Depressing the left brake pedal will turn off the Diff.

Wiring information:
C056-02 <-> C010-11 <-> 163-B (RT brake) 163-A <-> C8 splice <-> fuse 38
C056-03 <-> C010-10 <-> 162-A (LFT brake) 162-B <-> C8 splice <-> fuse 38

Corrective action:

STEP 1 - Check display
Turn key on. Watch the Diff lock icon on the display. Turn ON and OFF Diff lock switch in armrest. (Diff lock icon should turn ON and OFF)
Depress both brake pedal while watching the MFD icon (MFD icon should turn on if tractor is equipped with MFD).
-- OK - Diff lock icon turns on and off when armrest switch is actuated (look at icon on display) go to Step 6.
-- NOT OK - Diff lock icon does not turn on and off when armrest switch is actuated. (Look at icon on display) go to Step 2.
-- NOT OK - Fault code appears when Diff lock is switched on and off, troubleshoot new fault code.
-- NOT OK - MFD icon would turn on and off but the Diff lock icon would not. -Brake pedal switch is misadjusted.

STEP 2 - Check brake pedal switches circuit
Check the brake pedal switch function. 
-- OK - Both switches are in place and function correctly (open and close), go to Step 3.
-- NOT OK - Replace failed switch.

STEP 3 - 12 volt power check
Turn key on. Check right and left hand brake switch for 12 volt power.
-- OK - go to Step 4.
-- NOT OK - Failed wire between fuse 38 and brake switch.
STEP 4 - Disconnect brake pedal wires at the controller
Remove the controller cover from the rear of the tractor.
Remove connector C056 (gray) from the PTO controller.
Remove pins 2 and 3 from connector C056.
Install connector C056 and turn key on.
Watch the Diff lock icon on display and turn on and off the Diff lock switch in the armrest.
  -- OK - Diff lock icon now turns on and off when armrest switch is actuated. (Look at icon on the display) go to Step 5.
  -- NOT OK - Diff lock icon does not turn on and off when armrest switch is actuated. (Look at icon on display) go to Step 9.
  -- NOT OK - Fault code appears when Diff lock is switched on and off, troubleshoot new fault code.

STEP 5 - Check wiring
One of the wires from the brake pedal switches is shorted to power.
Turn key on and check pins 2 and 3 for 12 volts. (0 volts should be measured unless brake pedal is depressed)
  -- OK - Check brake pedal switch adjustment.
  -- NOT OK - Replace shorted wire between switch and PTO controller.

STEP 6 - Drive tractor
Drive the tractor and test Diff lock (turn off and on Diff lock when turning).
Engage Diff lock and depress left brake (Diff lock should turn off).
Engage Diff lock and depress right brake (Diff lock should turn off).
  -- OK - Diff lock turned off and on correctly.
  -- NOT OK - Icon on display turn on and of but Diff lock did not mechanically engage. Go to Step 7.
  -- NOT OK - Icon on display did not turn off when left or right brake was depressed. Go to Step 9.

STEP 7 - Check controller
Remove the Diff lock power supply wire Pin 9 from connector C057.
Install solenoid circuit tester CAS 2593-1 with a Diff lock test solenoid (9.0 - 10.2 ohms) in to cavity C057-9.
Attach connector C057 to the PTO controller.
Attach the loose lead of CAS 2593-1 to chassis ground.
Turn key on and engage and disengage the Diff lock.
  -- OK - Diff lock test solenoid turned off and on when switch was actuated the controller is OK. Go to Step 8.
  -- NOT OK - Diff lock test solenoid did not turn off and on when switch was actuated and no fault code was recorded, controller failed go to Step 14.

STEP 8 - Check tractor solenoid
Remove, clean and test Diff lock solenoid.
Attach test harness to Diff lock solenoid installed on tractor.
Lower cab.
Drive tractor and test Diff lock (turn off and on Diff lock when turning).
  -- OK - Diff lock turned off and on correctly, problem corrected.
  -- NOT OK - Icon on display turn on and of but Diff lock did not mechanically engage. Internal transmission problem.

STEP 9 - Check brake pedal switches circuit
Check the brake pedal switch function.
  -- OK - Both switches are in place and function correctly (open and close), go to Step 10.
  -- NOT OK - Replace failed switch.

STEP 10 - 12 volt power check
Turn key on.
Check right and left hand brake switch for 12 volt power.
  -- OK - Go to Step 11.
  -- NOT OK - Failed wire between fuse 38 and brake switch.
STEP 11 - Disconnect brake pedal wires at the PTO controller

One of the wires from the brake pedal switches is failed open.

Remove the rear controller cover.

Remove connector C056 (gray) from the PTO controller.

Install connector C056.

Turn key on and check pins 2 and 3 for 0 volts. (0 volts should be measured unless brake pedal is depressed)

Depress right brake, 12 volts must be measured at wire removed from C056-2.

Depress left brake, 12 volts must be measured at wire removed from C056-3.

-- OK - Test controller, go to Step 12.

-- NOT OK - Check the following:

1. Check brake pedal switch adjustment.
2. Check all connectors in circuit for pushed back or bent pins.
3. Replace failed wire between brake switch and PTO controller.

STEP 12 - Check controller

Remove the Diff lock power supply wire Pin 9 from connector C057.

Install solenoid circuit tester CAS 2593-1 with a Diff lock test solenoid (9.0 - 10.2 ohms) into cavity C057-9.

Attach connector C057 to the PTO controller.

Attach the loose lead of CAS 2593-1 to chassis ground.

Turn key on and engage and disengage the Diff lock.

-- OK - Diff lock test solenoid turned off and on when switch was actuated the controller is OK, go to Step 13.

-- NOT OK - Diff lock test solenoid did not turn off and on when switch was actuated and no fault code was recorded, controller failed go to Step 14.

STEP 13 - Check tractor solenoid

Remove, clean and test Diff lock solenoid.

Attach test harness to Diff lock solenoid installed on tractor.

Lower cab.

Drive the tractor and test Diff lock (turn off and on Diff lock when turning).

-- OK - Diff lock turned off and on correctly, problem corrected.

-- NOT OK - Icon on display turned on and off, but Diff lock did not mechanically engage. Internal transmission problem.

STEP 14 - Replace controller

Check that the wire to pin C057-9 is not shorted to power when the key is off before replacing controller.

Check that the wire harness routing of the controllers is installed against the cab (make sure wires are not loose or draped in front of controllers).

Write the problem on the failed controller.

Install and calibrate a new controller.
PTO CONTROLLER FAULT CODES

FAULT CODE PTO 1010 PTO On/Off Switch Failure

Cause:
The Data Bus signaled that the PTO on/off switch failed at armrest or the CAN_BUS signal does not match the PTO on signal.

Possible failure mode:
1. The PTO on/off switch failed in the armrest controller (in most cases).
2. PTO on wiring failure between the PTO controller and the armrest controller (fair chance).
3. Software execution error in the armrest controller (small chance).

Background:
The on position of the PTO off/on switch in the armrest controller is hard wired to the PTO controller. The PTO controller and the armrest controller both monitor the PTO switch position through the data bus.

Solution:
The PTO on/off switch is hard wired to the armrest controller. The PTO controller received the PTO on/off signal from the armrest through CAN_BUS. The PTO on signal is also directly wired to PTO controller from the armrest.

If the PTO on/off switch fails in the armrest controller, the fault code ARM 1039 should exist. If the PTO on wire between the PTO controller and the armrest controller fails, the fault code PTO 1016 or PTO 1017 may appear.

1. Check for fault code ARM 1039 at the armrest controller. If ARM 1039 exists, test the function of the PTO on/off switch.
   If a service tool is connected to the tractor Data Bus, do the following:
   Go to the Monitor screen by clicking on the Monitor Icon.
   Click the CHANGE PARAMETER SELECTIONS Icon.
   Click the PTO OFF SW and then ADD. You will be able to monitor the PTO on/off switch status on the screen.
   Turn the switch on and off, and watch the status change.
   If the status display matches the switch changes, the switch is working OK. If not, continue the test procedures.
   If the service tool is not connected to the tractor Data Bus or the status display does not match the switch changes, test the switch and its wiring.
   Follow the troubleshooting procedure for ARM 1039.

2. If ARM 1039 does not exists or the PTO on/off switch is working OK, then test the PTO on wiring from the armrest controller to the PTO controller. Pay attention to loose connectors, bent pins in the connector, and wire damage.

3. If none of the above or the problem is intermittent, the switch may be contaminated internally or the wiring may have started to deteriorate.

NOTE: See schematic sections 44, 45 and 49 at the rear of this section.
Fault Code PTO 1016 PTO On Switch Wire From Armrest To PTO Failed Open

Cause:
The Data Bus signaled that the PTO switch is ON, but the PTO ON wire shows open status.

Possible failure mode:
1. PTO on wiring failure between the PTO controller and the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

Solution:
The PTO on/off switch is hard wired to the armrest controller. The PTO controller received the PTO on/off signal from the armrest through the CAN BUS. The PTO on signal is also directly wired to PTO controller from the armrest.

If the PTO on/off switch fails in the armrest controller, fault code ARM 1039 should exist. If the PTO ON wire between the PTO controller and the armrest controller fails, fault code PTO 1016 or PTO 1017 may appear.

1. Check for fault code ARM 1039 at the armrest controller. If ARM 1039 exists, test the function of the PTO on/off switch.
   - If a service tool is connected to the tractor Data Bus, do the following:
     - Go to the Monitor screen by clicking on the Monitor Icon.
     - Click the CHANGE PARAMETER SELECTIONS Icon.
     - Click the PTO OFF SW and then ADD. You will be able to monitor the PTO on/off switch status on the screen.
     - Turn the switch on and off, and watch the status change.
       - If the status display matches the switch changes, the switch is working OK. If not, continue the test procedures.
       - If the service tool is not connected to the tractor Data Bus or the status display does not match the switch changes, test the switch and its wiring.
       - Follow the troubleshooting procedure for ARM 1039.

2. If ARM 1039 does not exist or the PTO on/off switch is working OK, then test the PTO on wiring from the armrest controller to the PTO controller.

3. If none of the above or the problem is intermittent, the switch may be contaminated internally or the wiring may have started to deteriorate.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 and 49 at the rear of this section.
FAULT CODE PTO 1017 PTO On Switch Wire From Armrest To PTO Failed Short

Cause:
The Data Bus signaled that the PTO switch is OFF, but the PTO ON wire shows ON status.

Possible failure mode:
1. PTO on wiring between the PTO controller and the armrest controller shorted to power (in most cases).
2. Software execution error in the armrest controller (small chance).

Solution:
The PTO on/off switch is hard wired to the armrest controller. The PTO controller received the PTO on/off signal from the armrest through CAN_BUS. The PTO on signal is also directly wired to PTO controller from the armrest.

If the PTO on/off switch fails in the armrest controller, the fault code ARM 1039 should exist. If the PTO on wire between the PTO controller and the armrest controller fails, the fault code PTO 1016 or PTO 1017 may appear.

1. Check for fault code ARM 1039 at the armrest controller. If ARM 1039 exists, test the function of the PTO on/off switch.
   If a service tool is connected to the tractor Data Bus, do the following:
   Go to the Monitor screen by clicking on the Monitor Icon.
   Click the CHANGE PARAMETER SELECTIONS Icon.
   Click the PTO OFF SW and then ADD. You will be able to monitor the PTO on/off switch status on the screen.
   Turn the switch on and off, and watch the status change.
   If the status display matches the switch changes, the switch is working OK. If not, continue the test procedures.
   If the service tool is not connected to the tractor Data Bus or the status display does not match the switch changes, test the switch and its wiring.
   Follow the troubleshooting procedure for ARM 1039.
2. If ARM 1039 does not exists or the PTO on/off switch is working OK, then test the PTO ON wiring from the armrest controller to the PTO controller.
3. If none of the above or the problem is intermittent, the switch may be contaminated internally or the wiring may have started to deteriorate.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 and 49 at the rear of this section.

FAULT CODE PTO 1030 Difflock Switch Failure

Cause:
The Data Bus signaled that the difflock switch has failed in AUTO position.

The PTO controller received the signal from the armrest controller.

Possible failure mode:
1. The difflock switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

Solution:
The difflock switch is hard wired to the armrest controller. If the difflock switch fails in the armrest controller, the fault code ARM 1079 should exist.

1. Check for fault code ARM 1079 at the armrest controller. If ARM 1079 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

NOTE: See schematic section 46 at the rear of this section.
Fault Code PTO 1040 MFD Switch Failure

Cause:
The Data Bus signaled that the MFD switch has failed in AUTO position.
The PTO controller received the signal from the armrest controller.

Possible failure mode:
1. The MFD switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

Solution:
The MFD switch is hard wired to the armrest controller. If the MFD switch fails in the armrest controller, the fault code ARM 1069 should exist.
1. Check for fault code ARM 1069 at the armrest controller. If ARM 1069 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic section 46 at the rear of this section.

Fault Code PTO 1050 MFD Switch Failure

Cause:
The Data Bus signaled that the MFD switch has failed in the ON position.
The PTO controller received the signal from the armrest controller.

Possible failure mode:
1. The MFD switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

Solution:
The MFD switch is hard wired to the armrest controller. If the MFD switch fails in the armrest controller, fault code ARM 1069 should exist.
1. Check for fault code ARM 1069 at the armrest controller. If ARM 1069 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic section 46 at the rear of this section.
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FAULT CODE PTO 1060 Difflock Switch Failure

Cause:
The Data Bus signaled that the difflock switch has failed in ON position.
The PTO controller received the signal from the armrest controller.

Possible failure mode:
1. The difflock switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

Solution:
The difflock switch is hard wired to the armrest controller. If the difflock switch fails in the armrest controller, fault code ARM 1079 should exist.

1. Check for fault code ARM 1079 at the armrest controller. If ARM 1079 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic section 46 at the rear of this section.

FAULT CODE PTO 1110 Difflock Switch Failure

Cause:
The Data Bus signaled that the difflock switch has failed.
The PTO controller received the signal from the armrest controller.

Possible failure mode:
1. The difflock switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

Solution:
The difflock switch is hard wired to the armrest controller. If the difflock switch fails in the armrest controller, fault code ARM 1079 should exist.

1. Check for fault code ARM 1079 at the armrest controller. If ARM 1079 exists, follow the corresponding corrective action.
2. Check the function the armrest controller

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic section 46 at the rear of this section.
FAULT CODE PTO 1120 MFD Switch Failure

Cause:
The Data Bus signaled that the MFD switch has failed.
The PTO controller received the signal from the armrest controller.

Possible failure mode:
1. The MFD switch failed in the armrest controller (in most cases).
2. Software execution error in the armrest controller (small chance).

Solution:
The MFD switch is hard wired to the armrest controller. If the MFD switch fails in the armrest controller, the fault code ARM 1069 should exist.
1. Check for fault code ARM 1069 at the armrest controller. If ARM 1069 exists, follow the corresponding corrective action.
2. Check the function the armrest controller.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic section 46 at the rear of this section.

FAULT CODE PTO 3020 Engine Speed Error

Cause:
The Data Bus signaled that the engine speed message is ‘error’ or ‘not available’ from instrument controller.

Possible failure modes:
1. Engine speed sensing failed in the instrument controller.
2. Software execution error in the instrument controller.

Solution:
1. Make sure the engine is running properly.
2. Recalibrate the instrumentation cluster.
3. Check the engine speed display on the instrumentation cluster.
4. If the instrument controller is not working properly, replace it.
Fault Code PTO 6013 PTO Solenoid Open Circuit

Cause:
PTO solenoid or its wiring has failed open.

Possible failure modes:
1. PTO solenoid coil failed open.
2. PTO solenoid failed shorted to ground.
3. PTO solenoid wiring circuit problems.
4. PTO controller failure (little chance).

Solution:
Check the PTO solenoid resistance and the wiring from the controller to the PTO solenoid.

1. Test the resistance of the PTO solenoid at the PTO controller connector (C057).
   Remove the controller cover from the rear of the tractor.
   Disconnect connector (C057) (black) from the PTO controller.
   Inspect pin 4 and pin 5 in the connector. Clean the connection.
   Clean the mating pin and connector.
   Test continuity between pin 4 and pin 5. The resistance should be approximately 8.5 - 9.7 ohms at 25 C (77 F).
   If the PTO solenoid resistance is not in the range, go to step 2.
   If it is as specified, start the engine and test the PTO again.
   If fault code is recorded again, go to step 4.
   If not, problem fixed.

2. Test the resistance of the PTO solenoid at the PTO solenoid connector (C159).
   Test continuity between pin A and pin B. The resistance should be approximately 8.5 - 9.7 ohms at 25 C (77 F).
   If the solenoid resistance is not in the range, replace the solenoid.
   If it is as specified, wiring problem. Go to step 3.

3. Check the wiring harness from connector C057 to C159.

4. Check the function of the PTO controller.
   Connect all connections. Make sure the controller has proper power and ground connection.
   Turn PTO on, there should be about 12 volts at pin 4 and low voltage at pin 5 of the connector C057.
   If not, replace the PTO controller.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 at the rear of this section.
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FAULT CODE PTO 6019 PTO Solenoid Short Circuit

Cause:
PTO solenoid or its wiring has shorted.

Possible failure mode:
1. Either side of PTO coil shorted to +12 volts.
2. PTO solenoid coil failed short (resistance too low).
3. PTO solenoid wiring circuit problems.
4. PTO controller failure (internal relay always on).

Solution:
Check the PTO solenoid resistance and the wiring from the controller to the PTO solenoid.

1. Test the resistance of the PTO solenoid at the PTO controller connector (C057).
   Remove the controller cover from the rear of the tractor.
   Disconnect connector (C057) (black) from the PTO controller.
   Inspect pin 4 and pin 5 in the connector. Clean the connection.
   Clean the mating pin and connector.
   Test continuity between pin 4 and pin 5. The resistance should be approximately 8.5 - 9.7 ohms at 25 C (77 F).
   If the PTO solenoid resistance is not in the range, go to step 2.
   If it is as specified, start the engine and test the PTO again.
   If fault code is recorded again, go to step 4.
   If not, problem fixed.

2. Test the resistance of the PTO solenoid at the PTO solenoid connector (C159).
   Test continuity between pin A and pin B. The resistance should be approximately 8.5 - 9.7 ohms at 25 C (77 F).
   If the solenoid resistance is not in the range, replace the solenoid.
   If it is as specified, wiring problem. Go to step 3.

3. Check the wiring harness from connector C057 to C159.

4. Check the function of the PTO controller.
   Connect all connections. Make sure the controller has proper power and ground connection.
   Turn PTO on, there should be about 12 volts at pin 4 and low voltage at pin 5 of the connector C057.
   Turn PTO off, the 12 volts at pin 4 of connector C057 should be gone.
   If the 12 volts at pin 4 stays on when PTO is turned off, replace the controller.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 at the rear of this section.
CLAIM CODE PTO 6084 Difflock Solenoid Failed Open or Short Circuit

Cause:
Difflock solenoid or its wiring has failed.

Possible failure modes:
1. Difflock solenoid coil failed.
2. Difflock solenoid wiring circuit problems.
3. PTO controller failure.

Solution:
Check the difflock solenoid resistance and the wiring from the controller to the difflock solenoid.

1. Test the resistance of the difflock solenoid at the PTO controller connector (C057).
   Remove the controller cover from the rear of the tractor.
   Disconnect connector (C057) (black) from the PTO controller.
   Inspect pin 9 in the connector. Clean the connection.
   Clean the mating pin and connector.
   Test continuity between pin 9 and the chassis ground. The resistance should be approximately 8.5 - 9.7 ohms at 25 C (77 F).
   If the solenoid resistance is not in the range, go to step 2.
   If it is as specified, start the engine and test the difflock again.
   If fault code is recorded again, go to step 4.
   If not, problem fixed.

2. Test the resistance of the solenoid at the difflock solenoid connector (C158).
   Test continuity between pin 1 and pin 2. The resistance should be approximately 8.5 - 9.7 ohms at 25 C (77 F).
   If the solenoid resistance is not in the range, replace the solenoid.
   If it is as specified, wiring problem. Go to step 3.

3. Check the wiring harness from connector C057 to C158.

4. Check the function of the PTO controller.
   Connect all connections. Make sure the controller has proper power and ground connection.
   Turn PTO on, there should be about 8 volts at pin 9 of the connector C057 when the difflock is turned on. If no voltage or the fault code appears when the difflock functions OK, replace the controller.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 at the rear of this section.
**FAULT CODE PTO 6094 MFD Solenoid Failure**

**Cause:**
Front wheel drive solenoid or its wiring has failed.

**Possible failure mode:**
1. MFD Solenoid coil failed.
2. MFD solenoid wiring circuit problems.
3. PTO controller failure.

**Solution:**
Check the MFD solenoid resistance and the wiring from the controller to the MFD solenoid.

1. Test the resistance of the MFD solenoid at the PTO controller connector (C057).
   - Remove the controller cover from the rear of the tractor.
   - Disconnect connector (C057) (black) from the PTO controller.
   - Inspect pin 10 in the connector. Clean the connection.
   - Clean the mating pin and connector.
   - Test continuity between pin 10 and the chassis ground. The resistance should be approximately 5.6 - 6.6 ohms at 25 C (77 F).
   - If the solenoid resistance is not in the range, go to step 2.
   - If it is as specified, start the engine and test the MFD again.
   - If fault code is recorded again, go to step 4.
   - If not, problem fixed.

2. Test the resistance of the solenoid at the MFD solenoid connector (C160).
   - Test continuity between pin 1 and pin 2. The resistance should be approximately 5.6 - 6.6 ohms at 25 C (77 F).
   - If the solenoid resistance is not in the range, replace the solenoid.
   - If it is as specified, wiring problem. Go to step 3.

3. Check the wiring harness from connector C057 to C160.

4. Check the function of the PTO controller.
   - Connect all connections. Make sure the controller has proper power and ground connection.
   - Turn PTO on, there should be about 8 volts at pin 10 of the connector C057 when the MFD is turned on. If no voltage or the fault code appears when the MFD functions OK, replace the controller.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**NOTE:** See schematic sections 44, 45 at the rear of this section.
FAULT CODE PTO 7014 Brake Light Relay Failure

**Cause:**
Brake light relay or its wiring has failed.

**Possible failure mode:**
1. Brake light relay failed.
2. Brake light relay wiring circuit problems.
3. PTO controller failure.

**Solution:**
Check the brake light relay solenoid resistance and the wiring from the controller to the brake light relay solenoid.

1. Test the resistance of the brake light relay solenoid at relay block RB 265.
   - Remove the brake light relay (relay 18) from relay block RB 265.
   - Test the relay solenoid resistance between pin 1 and pin 2. The resistance must be 105 to 115 ohms.
   - If the resistance is not within specifications, the relay must be replaced.
   - If the resistance is as specified, go to step 2.

2. Test the resistance of the brake light relay solenoid at PTO controller connector C057.
   - Remove the controller cover from the rear of the tractor.
   - Disconnect connector C057 (black) from the PTO controller.
   - Inspect pin 3 in the connector. Clean the connection. Clean the mating pin and connector.
   - Test the continuity between pin 3 and the chassis ground on the harness side. The resistance must be 105 to 115 ohms.
   - If the solenoid resistance is not within specifications, check the wiring harness from connector C057 to the brake light relay and to chassis ground.
   - If it is as specified, go to step 2.

3. Check the function of the PTO controller.
   - Connect all connections. Make sure the controller has proper power and ground connection.
   - Turn PTO on, there should be about 8 volts at pin 3 of the connector C057 when the brake light relay is turned on. If no voltage or the fault code appears and the brake light relay functions OK, replace the controller.

**NOTE:** Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

**NOTE:** See schematic sections 44, 45 and 34 at the rear of this section.
FAULT CODE PTO 9061 PTO Speed Sensor And PTO Shaft Sensor Connections Swapped

Cause:
The PTO controller receives the frequency signals from the two PTO sensors. If the frequency from the PTO shaft speed sensor is higher than the frequency from the PTO dual speed (shaft size) sensor for 5 seconds, this fault code is recorded.

Possible failure mode:
1. The two sensors are installed in reverse.
2. Sensor failure.

PTO SHAFT SPEED SIGNAL
The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

PTO SHAFT SIZE SPEED SIGNAL
The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use. i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

Solution:
Check the wiring from the PTO controller to the two speed sensors.
Make sure the two sensors are properly connected (i.e. the C145 and C336 are not installed in reverse).
Test the function of the two sensors.

1. Check the wiring harness to the PTO shaft speed sensor and the PTO dual speed (shaft size) sensor. Check the continuity from Pin 10 of connector C056 to Pin A of connector C145.
2. Check the continuity from Pin 12 of connector C056 to Pin A of connector C146 to Pin A of C336.
3. Check the continuity from Pin B of connector C145 and C336 to the chassis ground.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 at the rear of this section.
FAULT CODE PTO 9071 No PTO Shaft Size Signal When Configured For It

Cause:
The module is receiving no frequency from the shaft size sensor when configured as a two speed PTO tractor.

Possible failure mode:
1. The PTO system is equipped with only shaft speed sensor but configures as two speed system.
2. PTO shaft size sensor is not well connected or failed.
3. Wiring problem between PTO controller and the PTO shaft size sensor.

PTO SHAFT SPEED SIGNAL
The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

PTO SHAFT SIZE SPEED SIGNAL
The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use, i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

Solution:
Make sure the tractor has the PTO dual speed (shaft size) sensor installed and properly connected.
Check the wiring from the PTO controller to the shaft size sensor.
Test the function of the sensor.

1. Make sure the tractor has the PTO dual speed (shaft size) sensor installed and properly connected. If not, either reconfigure as a single speed sensor PTO system or add the shaft size sensor to the tractor.
2. Check the wiring harness to the PTO dual speed (shaft size) sensor.
Check the continuity from Pin 12 of connector C056 to Pin A of connector C336.
Check the continuity from Pin B of connector C336 to the chassis ground.
3. Check the function of the shaft size sensor. It should have resistance of about 3 K ohms.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 at the rear of this section.
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FAULT CODE PTO 9081 PTO Speed Sensor Configuration Error

Cause:
The controller is receiving frequency from the shaft size sensor when configured as a single speed tractor.

Possible failure mode:
1. The PTO is configured as single speed sensor system when equipped with dual speed (shaft size) sensor.

PTO SHAFT SPEED SIGNAL
The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

PTO SHAFT SIZE SPEED SIGNAL
The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use, i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

Solution:
Check the PTO dual speed (shaft size) sensor on the tractor. If it is installed, either reconfigure the tractor as a two speed sensor PTO system or disconnect the shaft size sensor.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 at the rear of this section.

FAULT CODE PTO 10031 Controller Memory Failure

Cause:
Controller memory error: loss of PTO and brake lamp configuration (EEPROM checksum error).

Possible failure mode:
1. Controller failure: memory defect or intermittent ECU.
2. Software defect.

Solution:
Make sure the controller has a good connection (C057) to the battery and is properly grounded.
Check the PTO controller configuration: the PTO SPEED and B LAMPS settings. If the settings hold the same as configured and the PTO, the MFD, and the difflock function properly, ignore the fault code. If the settings do not hold or the PTO, the MFD, and the difflock do not function properly, change the controller.

NOTE: See schematic sections 44, 45 at the rear of this section.
FAULT CODE PTO 10033 Battery Voltage Less Than 9.8 Volts

Possible failure mode:
1. Battery has failed.
2. Alternator regulator malfunction.
3. The controller has a bad connection to power or is not grounded properly.

Solution:
Check for battery voltage, alternator regulator output, and the controller connection to power and ground.
1. Check for fault codes Hitch 8001, ARM 8011, TRANS 8011, and AUX 8011. These are all fault codes for battery voltage low. If most exist, it is more likely that the battery voltage is low.
2. Test battery voltage. It should be around 12 - 14 volts.
3. If the battery voltage is OK, check system voltage at cavity 1 of connector C057.
   Check for bad connection and improper ground at cavity 12 of the same connector.
   Check for shortage to the ground along the power supply to the controller.
4. Test alternator output if the battery voltage would not hold even when the tractor has been running.
   The voltage should be above 14 volts at C077 - B+.
5. If none of above, check the function of the PTO controller.

NOTE: See schematic sections 44, 45 at the rear of this section.

FAULT CODE PTO 10035 Controller Failure

Cause:
Controller failed. ADC is returning an all one value.

Possible failure mode:
1. ADC locks up (maybe due to power surge).

Solution:
Make sure the controller has a good connection to the battery and is properly grounded. Shut down the tractor and start again. Calibrate the PTO controller again. If the same fault code appears after calibration, replace the controller.

NOTE: See schematic sections 44, 45 at the rear of this section.
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FAULT CODE PTO 10061 PTO Solenoid Power Supply
Relay Contact Voltage Out Of Range High

Cause:
There is an internal relay inside the PTO controller. This relay supplies voltage to the PTO solenoid when it is
energized. If it senses voltage when it is not energized, this fault code will be recorded.

Possible failure mode:
1. Controller internal relay stuck closed
2. Wires from the controller to the PTO solenoid shorted to power when the relay is not on.

Solution:
Check the external power shortage for PTO solenoid.
Check the function of the PTO controller internal relay.
1. Check for fault code PTO 6019. If it exists, follow the troubleshooting procedure.
2. Check for wire shortage to power:
   a. Disconnect connector C057 from the PTO controller.
   b. Check the voltage on terminal 4 and 5.
      There should be no voltage on any terminals.
      if there is voltage (above 1 volt) on any terminal, trace the wire for shortage.
   c. Pay attention to wire shortage between the power supply (terminal 1) and the PTO solenoid circuit (terminal
      4 and 5).
      if the resistance between any of them is low, check for wiring damage.
3. If no external shortage, check controller internal relay.
   The relay will kick on after the PTO is turned on and kick off after the PTO is turned off.
   A ‘click’ can be heard when listening carefully to the controller when the relay turns on or off. The ‘click’ can
   also be felt when the controller box is touched with a bare hand.
   Open the controller cover on the back of the tractor.
   Listen or feel for the relay ‘click’ when turn the PTO ON and then turn OFF.
   if there is click, the relay is working OK.
   if there is no click, replace the PTO controller.
   if the problem is intermittent, it may be caused by temperature change on a progressively deteriorating
   controller.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 at the rear of this section.
FAULT CODE PTO 54040 Hitch Raised Signal Failed In The Hitch Controller

Cause:
The Data Bus signaled that the hitch rockshaft position potentiometer has failed.
The PTO controller receives the signal from the hitch controller.

Possible failure mode:
1. The hitch rockshaft position potentiometer or its linkage failed in the hitch controller (in most cases).
2. Software execution error in the hitch controller (small chance).

HITCH ROCKSHAFT POTENTIOMETER FUNCTION
Potentiometer rotates 120 degrees (96 degree usable range).
The resistance is about 4 k ohm measured across pins A and C.
The resistance increase with clockwise rotation from 0 to about 4 k ohm measured across pin B and C.
Signal output from 0 to 5 VDC (1/24 volts per degree) at pin B when pin A is connected to power supply and pin C is grounded.

Solution:
The hitch rockshaft pot (C155) is hard wired to the hitch controller(C1059). If the hitch rockshaft potentiometer fails in the hitch controller, fault code HITCH 11069 should be recorded.

1. Check for fault code HITCH 11069 at the hitch controller. If hitch 11069 exists, follow the corresponding corrective action.
2. Check the function the hitch controller.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 51,52 at the rear of this section.
SECTION 55 - PTO CONTROLLER - CHAPTER 7

FAULT CODE PTO 54050 Wheel Slip Sensing Error
In The Instrumentation Controller

Cause:
The percent slip is decided by the difference between the wheel speed and the ground speed. The hitch controller receives the slip signal information from the instrumentation controller through the Data Bus.

Possible failure mode:
1. Wheel slip sensing (radar gun, wheel speed sensor) failed (in most cases).
2. Percent slip calculation failed in instrumentation controller (small chance).

RADAR FUNCTION
The radar is connected to the vehicle electrical system through a 4 pin connector.
Pin A: GND
Pin B: SIG
Pin C: B+
Pin D: Present
Pin A is the radar ground. Which is connected to the vehicle clean ground through SPL-F1.
Pin B is the radar signal. The signal is of square wave form with 'Low' 0.8 VDC or less and 'High' 3.7VDC minimum. Its frequency is scaled to 44 Hz/mph and proportional to ground speed. The signal is connected to the ICU pin 19 C061 through connector C060 Pin 25.
Pin C is the power supply to the radar from Fuse 34 through connector C010 pin 83.
Pin D is the signal from radar to ICU indicating radar is connected to the system. It is connected to the ICU Pin 13 through connector C060 Pin 28.

Solution:
The wheel speed sensor and the radar gun (for the ground speed) are hard wired to instrumentation controller. If the problem is with the wheel speed sender, then fault code HITCH 3010 and PTO 54060 should be recorded.

If there is no HITCH 3010 and PTO 54060, the problem is most likely with the radar gun. There is also a small chance of instrumentation controller malfunction.

1. Check the wiring of radar gun.
   Disconnect connector C068 at the radar.
   The power supply at pin C of connector C068 should be about 5 VDC when the tractor key is in the 'RUN' position.
   There should be good continuity from pin A of connector C068 to the clean ground.
   Check for open circuit and wiring shortage.

2. Check the function of the radar.
   The signal is from Pin B of the radar and connected to the pin 19 of the instrument cluster through Pin 25 of connector C060. The radar will detect the speed of any thing moving in front of it. So a quick hand moving in front of the radar will be an easy way to test the frequency change of the radar signal. Special tools (such as oscilloscope) is needed to check the frequency.
   If the radar does not work as expected, replace the radar in the following procedures:
   a. Disconnect the radar wiring.
   b. Remove the radar from the vehicle.
   c. Install the new radar.
   d. Reconnect the wiring and check the function of the new radar.

3. If there is no problem with the radar and its wiring, check the function of the instrumentation controller and the hitch controller.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 24, 25 and 26 at the rear of this section.
SECTION 55 - PTO CONTROLLER - CHAPTER 7

FAULT CODE PTO 54060 Ground Speed Signal Failed
In The Instrumentation Controller

Cause:
The Data Bus signaled that the transmission speed sensor has failed.
The PTO controller received the signal from the instrumentation controller.

Possible failure mode:
1. The transmission speed sensor failed (in most cases).
2. Software execution error in instrumentation controller (small chance).

WHEEL SPEED SENSOR INFORMATION
Cavity A: Signal
Cavity B: Ground
Operating Temperature: -40 degree C to 125 degree C
Resistance: 2700 to 3300 ohms
Inductance: 1.9 to 2.9 H
Output: 30 Hz to 7 kHz Quasi-Sinusoidal

Solution:
The speed sensor is hard wired to the instrumentation controller. The instrumentation controller sends the wheel (transmission) speed signal to the hitch controller and the PTO controller via Data Bus.

If the sensor or the instrumentation controller has a problem, both fault code HITCH 3010 and PTO 54060 should appear. If only PTO 54060 is recorded, the problem is most likely with the PTO controller.

1. If the service tool is connected to the tractor, do the following:
   Go to the Monitor screen by clicking on the Monitor Icon.
   Click the CHANGE PARAMETER SELECTIONS Icon.
   Select the INST GROUND SPEED - WHEEL and then ADD.
   You will be able to monitor the wheel speed sensor signal on the screen.
   Drive the tractor and watch the signal change when the tractor speed changes.
   If there is no wheel speed signal, go to step 2.
   If there is wheel speed signal, compare it to the speed display on the instrumentation cluster.
   If the speed signal looks fine on service tool but not on the instrumentation cluster, it is more likely a problem with the instrumentation cluster.
   If both signals seem fine, check the function of the PTO controller.

2. Test the resistance of the transmission speed sensor:
   Locate the transmission speed sensor on top of the transmission.
   Disconnect connector C069 from the sensor.
   Inspect the connector. Clean the connection.
   Measure the sensor resistance between pin A and Pin B.
   If the resistance is not in the specified range, replace the transmission speed sensor.
   If it is as specified, go to next step.

3. Check the wiring from the transmission speed sensor to connector C060 and then to connector C061 at the instrumentation controller.
   There should be 5 VDC power supply from pin28 of C061 to pin A of connector C069 when the tractor key is in the 'RUN' position.
   There should be good continuity from pin B of connector C069 to the clean ground.
   Check for open circuit and wiring shortage.

4. If none of above, check the function of the instrumentation controller and the PTO controller.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 24, 25 and 26 and 12 thru 18 at the rear of this section.
FAULT CODE PTO 54070 Engine Hours Signal Error
In The Instrument Controller

Cause:
The Data Bus signaled that engine hours signal error in the instrument controller.

Possible failure mode:
1. Engine hours EEPROM checksum error in the instrument controller.
2. Software execution error in the instrument controller.

Solution:
Check for fault code INST 10031 at the instrument controller. Follow the corresponding corrective action.

FAULT CODE PTO 54080 Transmission Oil Temperature Sensor Failed
In The Instrument Controller

Cause:
The Data Bus signaled that the transmission oil temperature sensor failed in the instrument controller.

Possible failure mode:
1. Transmission oil temperature sensor failed in instrument controller (in most cases).
2. Software execution error in the instrument controller (some chance).

Solution:
The transmission oil temperature sensor is hard wired to the instrument controller. If the transmission oil temperature sensor fails in the instrument controller, fault code INST 13021 or 13022 should be recorded.

1. Check for fault code INST 13021 and 13022 at the instrument controller. If either exists, follow the corresponding corrective action.
2. Check the function the instrument controller.

FAULT CODE PTO 54090 Trailing Implement Raised Signal Failed
In The Performance Controller

Cause:
The Data Bus signaled that the trailing implement up switch failed in the performance controller.

Possible failure mode:
1. Trailing implement up switch failed in the performance controller.
2. Software execution error in the performance controller.

Solution:
The trailing implement up switch is mounted on a trailing implement and hard wired to the performance controller. When that trailing implement is raised, the signal will be sensed by the performance controller.

Check the trailing implement up switch and the wiring from the switch to the performance controller. If nothing has failed, check the function the performance controller.
FAULT CODE PTO 54120 Communication Lost With The Armrest Controller

Cause:
PTO controller is not receiving or recognizing information from the armrest controller.

Possible failure mode:
1. Bad connection between PTO controller and the armrest controller.
2. Controller failure.

Solution:
Make sure both the armrest controller and the PTO controller are functioning OK.
Check the Data Bus connections.

1. Check the function of the PTO controller:
   a) Make sure the connector (C056) to the PTO controller is plugged in.
   b) Check the LED light on the PTO controller.
      LED lamp on - failed controller, replace the controller.
      LED lamp flashing - controller is OK.
      LED off - no power to controller, check power supply and its fuse.

2. Check the function of the armrest controller:
   a) Make sure the connector C137 to the armrest controller is plugged in.
   b) Check the LED light on the armrest controller.
      LED lamp on - failed controller, replace the controller.
      LED lamp flashing - controller is OK.
      LED off - no power to controller, check power supply and its fuse.

NOTE: The LED lamp for the armrest controller is located on the controller circuit board. It can be seen by looking through the opening next to connector C137 from the rear of the armrest.

3. Check the power supply to the Data Bus.
   The power supply to the Data Bus is from the switched power through Fuse #41.
   a) Make sure Fuse #41 is not burned out.
   b) Turn the tractor key 'ON'. Check the power supply at Fuse #41. There should be 12 volts.
      If not, check the power supply from the switched power.

4. Check the integrity of Data Bus at the passive terminators.
The following checks are basically looking into one end of the data bus and checking the terminator at the other end.
   a) Check from the passive terminator at the rear of the tractor.
      Disconnect the terminator at connector C175.
      With the key on, measure the voltage on the wires connected to C175.
      At pin 1, the red wire, it should read 12 volts battery voltage.
      At pin 2, the yellow wire, it should read 2.5 to 4 volts (2.5 V nominally).
      At pin 3, there should be continuity from pin 3 to the clean ground.
      At pin 4, the green wire, it should read 2.5 to 1 volts (2.5 V nominally).
      If the above checks are OK, it means that the front terminator and data bus wiring is OK.
      If not, go to next.
   b) Check from the passive terminator at the front of the tractor.
      Reconnect the rear terminator and disconnect the front terminator at connector C205.
      With the key on, measure the voltage on the wires connected to C205.
      At pin 1, the red wire, it should read 12 volts battery voltage.
      At pin 2, the yellow wire, it should read 2.5 to 4 volts (2.5 V nominally).
      At pin 3, there should be continuity from pin 3 to the clean ground.
      At pin 4, the green wire, it should read 2.5 to 1 volts (2.5 V nominally).
      If the above checks are OK, it means that the rear terminator and data bus wiring is OK.
      If not, check for bad connection and damaged wire along the Data Bus.
NOTE: When there is a bad connection along the Data Bus wiring, the fault code will be accompanied by multiple fault codes such as TRANS 12011, PTO 54120, INST 12011, AUX 12011, INST 12031, PERF 12031, TRANS 12031 and PTO 54140.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44.45 and 49 at the rear of this section.

NOTE: Also see the data bus schematic foldout at the end of this section.
FAULT CODE PTO 54130 Communication Lost With The Instrumentation Controller

Cause:
Communication lost between PTO controller and instrumentation controller.

Possible failure mode:
1. Bad connection between PTO controller and instrumentation controller.
2. Controller failure.

Solution:
Make sure both the instrumentation controller and the PTO controller are functioning OK.
Check the Data Bus connections.
1. Check the function of the PTO controller:
   a) Make sure the connector (C056) to the PTO controller is plugged in.
   b) Check the LED lamp on the PTO controller.
      LED lamp on - failed controller, replace the controller.
      LED lamp flashing - controller is OK.
      LED off - no power to controller, check power supply and its fuse.
2. Check the function of the Instrument controller:
   a) If there is no display and no back light on the tractor instrumentation, it is most likely that there is no power to the controller. Check the power supply, its fuse, and the ground to the controller. Make sure the connector (C061) to the instrument controller is plugged in.
   b) If there is display on the tractor instrumentation but the display is erratic, such as unusual symbols, and other controllers claim communication lost with the instrument controller, it is most likely the instrument controller has failed. Replace the controller.
   c) If nothing wrong can be found with the instrument controller, go to step 3.
3. Check the power supply to the Data Bus.
The power supply to the Data Bus is from the switched power through Fuse #41.
   a) Make sure Fuse #41 is not burned out.
   b) Turn the tractor key ‘ON’. Check the power supply at Fuse #41. There should be 12 volts.
      If not, check the power supply from the switched power.
4. Check the integrity of Data Bus at the passive terminators
   The following checks are basically looking into one end of the data bus and checking the terminator at the other end.
   a) Check from the passive terminator at the rear of the tractor.
      Disconnect the terminator at connector C175.
      With the key on, measure the voltage on the wires connected to C175.
      At pin 1, the red wire, it should read 12 volts battery voltage.
      At pin 2, the yellow wire, it should read 2.5 to 4 volts (2.5 V nominally).
      At pin 3, there should be continuity from pin 3 to the clean ground.
      At pin 4, the green wire, it should read 2.5 to 1 volts (2.5 V nominally).
      If the above checks are OK, it means that the front terminator and data bus wiring is OK.
      If not, go to next.
   b) Check from the passive terminator at the front of the tractor.
      Reconnect the rear terminator and disconnect the front terminator at connector C205.
      With the key on, measure the voltage on the wires connected to C205.
      At pin 1, the red wire, it should read 12 volts battery voltage.
      At pin 2, the yellow wire, it should read 2.5 to 4 volts (2.5 V nominally).
      At pin 3, there should be continuity from pin 3 to the clean ground.
      At pin 4, the green wire, it should read 2.5 to 1 volts (2.5 V nominally).
      If the above checks are OK, it means that the rear terminator and data bus wiring is OK.
      If not, check for bad connection and damaged wire along the Data Bus.
NOTE: When there is a bad connection along the Data Bus wiring, the fault code will be accompanied by multiple fault codes such as TRANS 12011, PTO 54120, INST 12011, AUX 12011, INST 12031, PERF 12031, TRANS 12031 and PTO 54140.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 and 24 at the rear of this section.

NOTE: Also see the data bus schematic foldout at the end of this section.
FAULT CODE PTO 54150 Communication Lost With the Hitch Controller

Cause:
PTO controller is not receiving or recognizing information from the hitch controller.

Possible failure mode:
1. Bad connection between PTO controller and the hitch controller.
2. Controller failure.

Solution:
Make sure both the hitch controller and the PTO controller are functioning OK.
Check the Data Bus connections.
1. Check the function of the PTO controller:
   a) Make sure the connector (C056) to the PTO controller is plugged in.
   b) Check the LED lamp on the PTO controller.
      LED lamp off - bad connection, replace the controller.
      LED lamp flashing - bad connection, replace the controller.
   1) Check the function of the hitch controller:
      a) Make sure the connector to the hitch controller is plugged in.
      b) Check the LED lamp on the hitch controller.
         LED lamp on - bad controller, replace the controller.
         LED lamp flashing - controller is OK.
         LED off - no power to controller, check power supply and its fuse.
   2. Check the power supply to the Data Bus.
      The power supply to the Data Bus is from the switched power through Fuse #41.
      a) Make sure Fuse #41 is not burned out.
      b) Turn the tractor Key ‘ON’. Check the power supply at Fuse #41. There should be 12 volts.
         If not, check the power supply from the switched power.
   3. Check the integrity of Data Bus at the passive terminators.
      The following checks are basically looking into one end of the data bus and checking the terminator at the other end.
      a) Check from the passive terminator at the rear of the tractor.
         Disconnect the terminator at connector C175.
         With the key on, measure the voltage on the wires connected to C175.
         At pin 1, the red wire, it should read 12 volts battery voltage.
         At pin 2, the yellow wire, it should read 2.5 to 4 volts (2.5 V nominally).
         At pin 3, there should be continuity from pin 3 to the clean ground.
         At pin 4, the green wire, it should read 2.5 to 1 volts (2.5 V nominally).
         If the above checks are OK, it means that the rear terminator and data bus wiring is OK.
         If not, go to next.
         b) Check from the passive terminator at the front of the tractor.
            Reconnect the rear terminator and disconnect the front terminator at connector C205.
            With the key on, measure the voltage on the wires connected to C205.
            At pin 1, the red wire, it should read 12 volts battery voltage.
            At pin 2, the yellow wire, it should read 2.5 to 4 volts (2.5 V nominally).
            At pin 3, there should be continuity from pin 3 to the clean ground.
            At pin 4, the green wire, it should read 2.5 to 1 volts (2.5 V nominally).
            If the above checks are OK, it means that the rear terminator and data bus wiring is OK.
            If not, check for bad connection and damaged wire along the Data Bus.
NOTE: When there is a bad connection along the Data Bus wiring, the fault code will be accompanied by multiple fault codes such as TRANS 12011, PTO 54120, INST 12011, AUX 12011, INST 12031, PERF 12031, TRANS 12031 and PTO 54140.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44.45 and 51.52 at the rear of this section.

NOTE: Also see the data bus schematic foldout at the end of this section.
FAULT CODE PTO 54170 Communication Lost With The Performance Controller

Meaning:
PTO controller is not receiving or recognizing information from the performance controller.

Possible failure mode:
1. Bad connection between PTO controller and the performance controller.
2. Controller failure.

Corrective Action:
Make sure both the performance and the PTO controller are functioning OK.
Check the Data Bus connections.

1. Check the function of the PTO controller:
   a) Make sure the connector (C056) to the PTO controller is plugged in.
   b) Check the LED lamp on the PTO controller.
      LED lamp on - failed controller, replace the controller.
      LED lamp flashing - controller is OK.
      LED off - no power to controller, check power supply and its fuse.

2. Check the function of the performance controller:
   a) If there is no display and no back light on the performance monitor, it is most likely that there is no power to the controller. Check the power supply, its fuse, and the ground to the controller. Make sure the connector (C062) to the performance controller is plugged in.
   b) If there is a display on the performance monitor but the display is erratic, such as unusual symbols, and other controllers claim communication lost with the performance controller, it is most likely the performance controller has failed, replace the controller.
   c) If the display is normal, go to step 3.

3. Check the power supply to the Data Bus.
   The power supply to the Data Bus is from the switched power through Fuse #41.
   a) Make sure Fuse #41 is not burned out.
   b) Turn the tractor Key 'ON'. Check the power supply at Fuse #41. There should be 12 volts.
      If not, check the power supply from the switched power.

4. Check the integrity of Data Bus at the passive terminators.
   The following checks are basically looking into one end of the data bus and checking the terminator at the other end.
   a) Check from the passive terminator at the rear of the tractor.
      Disconnect the terminator at connector C175.
      With the key on, measure the voltage on the wires connected to C175.
      At pin 1, the red wire, it should read 12 volts battery voltage.
      At pin 2, the yellow wire, it should read 2.5 to 4 volts (2.5 V nominally).
      At pin 3, there should be continuity from pin 3 to the clean ground.
      At pin 4, the green wire, it should read 2.5 to 1 volts (2.5 V nominally).
      If the above checks are OK, it means that the front terminator and data bus wiring is OK.
      If not, go to next.
   b) Check from the passive terminator at the front of the tractor.
      Reconnect the rear terminator and disconnect the front terminator at connector C205.
      With the key on, measure the voltage on the wires connected to C205.
      At pin 1, the red wire, it should read 12 volts battery voltage.
      At pin 2, the yellow wire, it should read 2.5 to 4 volts (2.5 V nominally).
      At pin 3, there should be continuity from pin 3 to the clean ground.
      At pin 4, the green wire, it should read 2.5 to 1 volts (2.5 V nominally).
      If the above checks are OK, it means that the rear terminator and data bus wiring is OK.
      If not, check for bad connection and damaged wire along the Data Bus.
NOTE: When there is a bad connection along the Data Bus wiring, the fault code will be accompanied by multiple fault codes such as TRANS 12011, PTO 54120, INST 12011, AUX 12011, INST 12031, PERF 12031, TRANS 12031 and PTO 54140.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44,45 and 27 at the rear of this section.

NOTE: Also see the data bus schematic foldout at the end of this section.
SECTION 55 - PTO CONTROLLER - CHAPTER 7

FAULT CODE PTO 54211 PTO Clutch Slipping Too Much

Cause:
The PTO controller monitors the PTO clutch input and output speed. This fault code is recorded when the difference of the input and output is beyond the limit.

Possible failure mode:
1. PTO load too heavy.
2. PTO clutch pressure too low.
3. PTO speed sensor or its wiring harness failure.
4. Incorrect engine RPM signal from the alternator.

Solution:
Make sure there is no PTO clutch slippage caused by either a heavy implement load or PTO clutch internal problem.
Test the PTO speed sensor and its wiring harness.
1. Turn off tractor engine. Check the implement connected to the PTO. Make sure the load is proper.
2. If there is visible PTO shaft slippage with or without implement load, check for fault code PTO 6013, 6015, 6019, and 10061. If any exist, follow the corresponding corrective action.
   If none exists, check the PTO clutch pressure and PTO valve. Check for sticking solenoid, sticking valve spool, leaking clutch seal, burned clutch pad, or broken PTO shaft.
3. Check the alternator and the engine RPM signal from the alternator.
   The PTO clutch input speed is the engine RPM signal from the alternator.
   a. Make sure the alternator is the correct model. Incorrect alternator will give wrong signal frequency which may trigger this fault code.
   b. Check for worn alternator belt.
   c. Check the engine RPM signal wiring. There should be good continuity between cavity 1 of PTO connector C056 and the terminal W of the alternator.
   d. Check the engine RPM signal at terminal W of the alternator.
   e. Go to the monitor screen of the service tool. Select parameter PTO ENGINE SPEED FREQUENCE. This is the PTO clutch input speed.
4. Check the wiring harness to the PTO shaft speed sensor.
   Check the continuity from Pin 10 of connector C056 to Pin A of connector C145.
   Check the continuity from Pin B of connector C145 to the chassis ground.
5. Check the function of the PTO speed sensor. It should have resistance of about 3 K ohms.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 and 19 and 27 at the rear of this section.
FAULT CODE PTO 54221 No Shaft Rotation Following Engagement

Cause:
The PTO controller monitors the PTO clutch output speed. This fault code is triggered if the PTO controller does not detect PTO shaft rotation after engagement.

Possible failure mode:
1. PTO shaft locked up by the implement.
2. PTO solenoid is not energized or spool stuck in the OFF position.
3. PTO clutch pressure too low.
4. PTO speed sensor or its wiring harness failure.

PTO SHAFT SPEED SIGNAL
The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal waveform which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

PTO SHAFT SIZE SPEED SIGNAL
The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use; i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

Solution:
Make sure the PTO clutch is not locked up by heavy implement load. If it is still not turning without heavy implement load, check for PTO solenoid and PTO clutch problem. If it is turning, test the PTO speed sensor and its wiring harness.

1. Turn off tractor engine. Check the implement connected to the PTO. Make sure the load is proper.
2. If the PTO shaft does not turn even without any implement load, check for fault code PTO 6013, 6015, 6019, and 10061.
   If any exist, follow the corresponding corrective action.
   If none exists, check the PTO clutch pressure and PTO valve. Check for sticking solenoid, sticking valve spool, leaking clutch seal, burned clutch pad, or broken PTO shaft.
3. If the PTO shaft turns or it turns for 5 seconds when it is turned on and then stops, go to step 4 and 5.
4. Check the wiring harness to the PTO shaft speed sensor.
   Check the continuity from Pin 10 of connector C056 to Pin A of connector C145,
   Check the continuity from Pin B of connector C145 to the chassis ground.
5. Check the function of the PTO speed sensor. It should have resistance of about 3 K ohms.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 at the rear of this section.
SECTION 55 - PTO CONTROLLER - CHAPTER 7

FAULT CODE PTO 54241 PTO Shaft Is Spinning When Engine Is Off

Cause:
The PTO controller monitors the PTO clutch output speed. This fault code is recorded if the PTO controller has detected PTO shaft rotation when engine is off.

Possible failure mode:
1. Implement attached to tractor caused the PTO to turn.
2. PTO speed sensor or its wiring harness failure.

PTO SHAFT SPEED SIGNAL
The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

PTO SHAFT SIZE SPEED SIGNAL
The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use; i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

Solution:
Make sure the implement attached to tractor is not causing the PTO to turn. Test the PTO speed sensor and its wiring harness.
1. Make sure the implement attached to tractor is not causing the PTO to turn.
2. Restart the tractor after PTO switch moved to OFF position. Turn PTO on and off to check the shaft spinning.
3. Monitor the engine speed and PTO speed either at Instrument cluster or using the service tool. If there is no engine speed display when the engine is running, go to step 4. If there is PTO speed display when the engine is not running, go to step 5 and 6.
4. Check the engine RPM signal.
   a) Check the engine RPM signal wiring. There should be good continuity between cavity 1 of PTO connector C056 and the terminal W of the alternator.
   b) Check the engine RPM signal at terminal W of the alternator.
5. Check the wiring harness to the PTO shaft speed sensor.
   Check the continuity from Pin 10 of connector C056 to Pin A of connector C145.
   Check the continuity from Pin B of connector C145 to the chassis ground.
6. Check the function of the PTO speed sensor. It should have resistance of about 3 K ohms.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 at the rear of this section.
SECTION 55 - PTO CONTROLLER - CHAPTER 7

FAULT CODE PTO 54251 PTO Shaft Is Spinning When Clutch Is Off

Cause
The PTO controller monitors the PTO clutch output speed. This fault code is recorded if the PTO controller has detected PTO shaft rotation when PTO is turned off for 45 seconds.

Possible failure mode:
1. The PTO brake not functioning.
2. The clutch is not really turned off.
3. Implement attached to tractor had caused the PTO to turn.
4. PTO speed sensor or its wiring harness failure.

PTO SHAFT SPEED SIGNAL
The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

PTO SHAFT SIZE SPEED SIGNAL
The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use; i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

Solution:
Make sure the implement attached to tractor is not causing the PTO to turn. If the PTO is still turning when it is turned off, check for PTO solenoid and PTO clutch problem. If it is not turning, test the PTO speed sensor and its wiring harness.

1. Turn off tractor engine. Check the implement connected to the PTO. Make sure it is not causing the PTO to turn.
2. If the PTO is still turning when it is turned off, check for fault code PTO 6015 and 10061. If any exist, follow the corresponding corrective action.
3. If the PTO shaft stops turning after it turned off and the fault code is still recorded, go to step 4 and 5.
4. Check the wiring harness to the PTO shaft speed sensor.
   Check the continuity from Pin 10 of connector C056 to Pin A of connector C145.
   Check the continuity from Pin B of connector C145 to the chassis ground.
5. Check the function of the PTO speed sensor. It should have resistance of about 3 K ohms.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 at the rear of this section.
FAULT CODE PTO 54261 Engine Stalled When The PTO Was Running

Cause:
The PTO controller monitors the engine RPM signal from the alternator. This fault code is recorded when the PTO controller has detected that the engine has stalled while the PTO was running.

Possible failure mode:
1. Engine stalled when PTO was running.
2. Engine RPM signal wrong.

Solution:
If the engine is stalled while engaging the PTO, check the root cause for the engine stalling.
If the engine is not stalled while this fault code is still recorded, check the engine RPM signal.
1. If the engine is stalled while engaging the PTO, check the root cause for the engine stalling.
   Make sure the implement load is proper. Check for the following problems:
   - Low battery charge or voltage.
   - Loose battery or starter connection.
   - Loose ground on battery or to chassis.
   - Poor fuel quality (fuel gels in cold weather).
   - Fuel wiring to or fuel shutoff solenoid on injection pump failed.
   Measure primer pump pressure.
2. If the engine is not stalled while this fault code is still recorded, check the engine RPM signal.
   a) Check the engine RPM signal wiring. There should be good continuity between cavity 1 of PTO connector C056 and the terminal W of the alternator.
   b) Check the engine RPM signal at terminal W of the alternator.

NOTE: See schematic sections 44, 45 at the rear of this section.
FAULT CODE PTO 54272 PTO Shaft Overspeed Detected

Cause:
The PTO controller monitors the PTO clutch input and output speed. This fault code is recorded when the PTO controller has detected a PTO speed that is 20% higher than expected for more than 2 seconds.

Possible failure modes:
1. PTO load is driving the PTO.
2. Wrong signal from the shaft speed sensor.
3. Incorrect alternator installed.

PTO SHAFT SPEED SIGNAL
The PTO shaft speed frequency is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

PTO SHAFT SIZE SPEED SIGNAL
The PTO shaft size speed frequency is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use; i.e. 1-3/4” 1000 RPM, 1-3/8” 1000 RPM or 1-3/8” 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

Solution:
Make sure the PTO shaft is not driven by the load such as in the down hill situation.
Test the PTO speed sensor and its wiring harness.
1. Check the PTO operation is correct and the external load is not driving the shaft.
2. Check the wiring harness to the PTO shaft speed sensor.
   - Check the continuity from Pin 10 of connector C056 to Pin A of connector C145.
   - Check the continuity from Pin B of connector C145 to the chassis ground.
3. Check the function of the PTO shaft speed sensor. It should have resistance of about 3 K ohms.
4. Check the alternator and the engine RPM signal from the alternator.
   a. Make sure the alternator is the correct model. Incorrect alternator will give wrong signal frequency which may trigger this fault code.
   b. Check for worn alternator belt.
   c. Check the engine RPM signal wiring. There should be good continuity between cavity 1 of PTO connector C056 and the terminal W of the alternator.
   d. Check the engine RPM signal at terminal W of the alternator.
   e. Go to the monitor screen of the service tool. Select parameter PTO ENGINE SPEED FREQUENCE. This is the PTO clutch input speed.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 44, 45 at the rear of this section.
FAULT CODE PTO 54282 PTO Not Reach Lock Up Speed Within 6 Seconds Of Being Turned On

Cause:
The PTO controller monitors the PTO clutch input and output speed. This fault code is recorded when the PTO does not reach lock up speed within 6 seconds of being turned on.

Possible failure modes:
1. PTO load too heavy.
2. PTO clutch pressure too low.
3. PTO solenoid is not energized.
4. PTO speed sensor and its wiring harness failure.
5. Incorrect alternator installed.

PTO SHAFT SPEED SIGNAL
The PTO shaft speed signal is derived from a variable reluctance speed sensor in the transmission. The clutch speed sensor is connected directly to the PTO control module in all versions of the PTO control system. The sensor output is directly proportional to PTO clutch output speed, and is a quasi-sinusoidal wave form the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 3,200 Hz worst case.

PTO SHAFT SIZE SPEED SIGNAL
The PTO shaft size speed signal is derived from a variable reluctance speed sensor in the transmission. The sensor is connected directly to the PTO control module and its output is proportional to PTO clutch output speed, but scaled differently from the PTO clutch speed signal depending upon which PTO shaft is in use; i.e. 1-3/4" 1000 RPM, 1-3/8" 1000 RPM or 1-3/8" 540 RPM. The signal is a quasi-sinusoidal waveform the amplitude of which is non-linearly proportional to speed. The amplitude range of the signal is from 3 volts peak-to-peak to 80 volts peak-to-peak centered around chassis ground. Frequency range is from zero to 760 Hz worst case.

PTO CLUTCH SLIPPAGE
The PTO clutch slippage limit is set as the follow:
PTO clutch slip> +/-15 % for 5 seconds

Solution:
Make sure there is no PTO clutch slippage caused by either heavy implement load or PTO clutch internal problem.

Test the PTO speed sensor and its wiring harness.
Test the alternator and the engine RPM signal from the alternator.
1. Make sure the alternator is the correct model. Incorrect alternator will give wrong signal frequency which may trigger this fault code.
2. Check for worn alternator belt.
3. Check the engine RPM signal wiring. There should be good continuity between cavity 1 of PTO connector C056 and the terminal W of the alternator.
4. Check the engine RPM signal at terminal W of the alternator.
5. Go to the monitor screen of the service tool. Select parameter PTO ENGINE SPEED FREQUENCE. This is the PTO clutch input speed.

4. If the PTO shaft turns or it turns for 5 seconds when it is turn on and then stops, go to step 5 and 6.
5. Check the wiring harness to the PTO shaft speed sensor.
   Check the continuity from Pin 10 of connector C056 to Pin A of connector C145.
   Check the continuity from Pin B of connector C145 to the chassis ground.

6. Check the function of the PTO speed sensor. It should have resistance of about 3 K ohms.

NOTE: Always inspect connector ends for damaged, bent or dislocated pins when troubleshooting.

NOTE: See schematic sections 19, 27 and 44, 45 at the rear of this section.
FAULT CODE PTO 65535 Memory Not Cleared From The Factory

Cause:
The PTO controller memory has not been cleared from the factory.

Solution:
This is a non fault. Clear the fault code from the controller.
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SECTION 55 - PTO CONTROLLER - CHAPTER 7

OPTIONAL FRONT HITCH LAMPS

CHASSIS GROUND

SECTION 27

SECTION 572 SHT

AT SPLICE F3

TO CLEAN GROUND

SECTION 241 SHT

AT SPLICE C20 TO UNSWITCHED B+

87 10M

87 10F

1234332M

4321332F

fh1

fh2

0.8-DU

0.8-DU

0.8-DU

0.8-DU

0.8-DU

1.0-R

1.0-R

1.0-R

1.0-R

1.0-R

0.8-Bk

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