

RD: Nitrogen Oxides (NOx)

Note: Clearing the PCM DTCs erases any PCM recorded freeze frame data. Record any PCM freeze frame information before proceeding.

Note: Regeneration may occur during normal operation. During regeneration, diagnostic procedures may display biased values. If a regeneration occurs during diagnostic procedures, allow the process to complete before continuing diagnostics.

This pinpoint test is intended to diagnose the following:

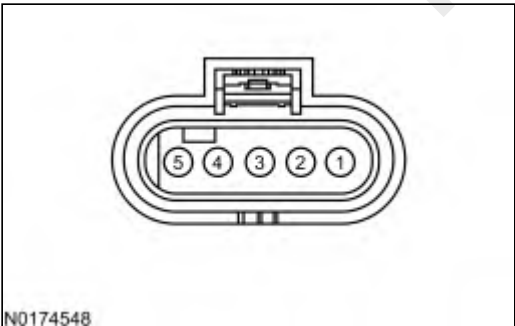
- harness circuits: VPWR, PWRGND, GND, CAN2+, and CAN2-
- nitrogen oxides bank 1, sensor 1 (NOx11) sensor (5J299)
- nitrogen oxides bank 1, sensor 2 (NOx12) sensor (5J299)
- NOx11 module (5K202)
- NOx12 module (5K202)
- NOx11 module and sensor assembly (5L248)
- NOx12 module and sensor assembly (5E145)

Nitrogen Oxides Bank 1, Sensor 1 (NOx11) Module Connector

A



B

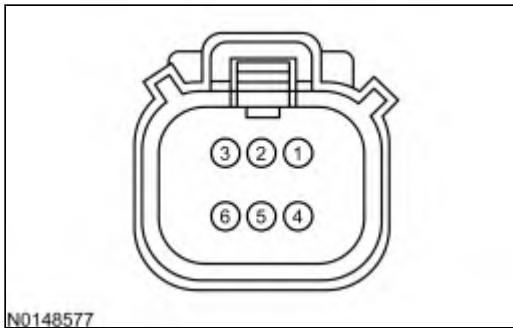


Vehicle	Connector	Pin	Circuit
F-650 / F-750, Transit	A	1, 4 2 5 6	GND CAN2- CAN2+ VPWR

Vehicle	Connector	Pin	Circuit
All other vehicles	B	4 3 2 1	GND CAN2- CAN2+ VPWR

Nitrogen Oxides Bank 1, Sensor 2 (NOx12) Module Connector

A



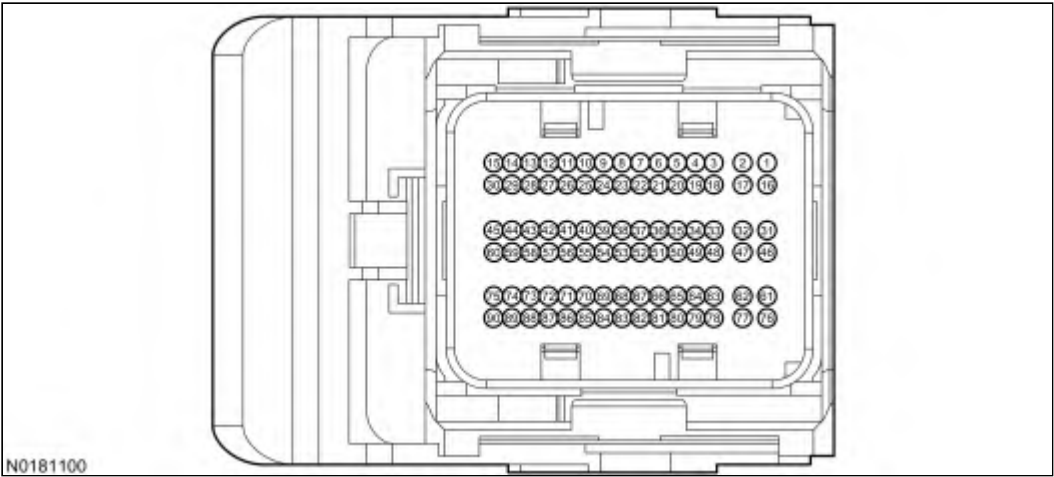
B



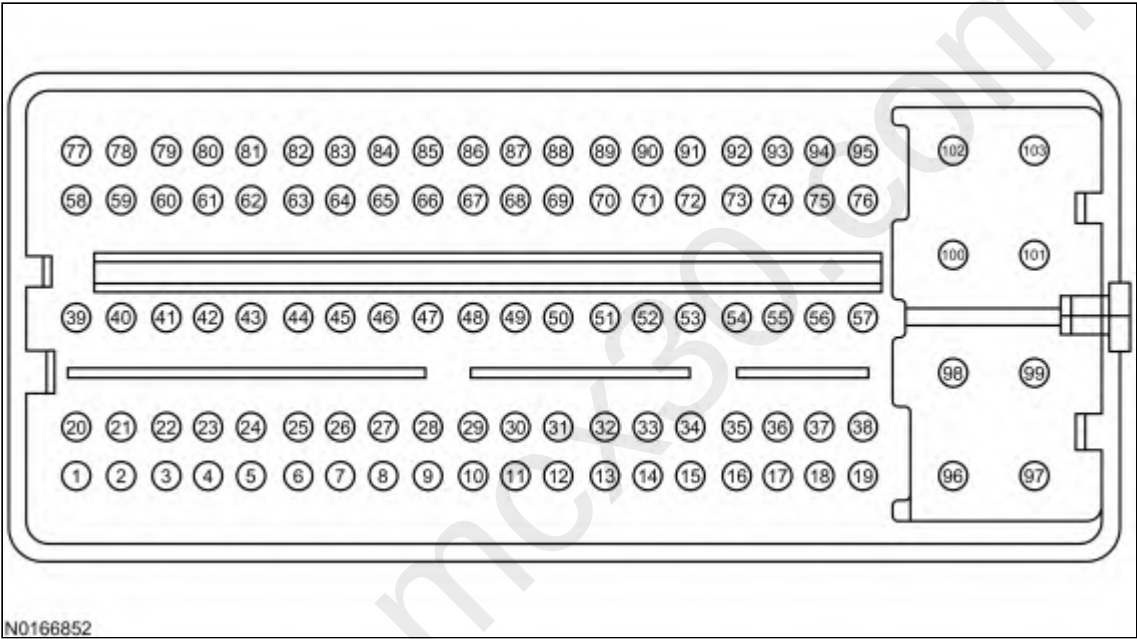
Vehicle	Connector	Pin	Circuit
F-650 / F-750, Transit	A	1, 4 2 5 6	GND CAN2- CAN2+ VPWR
F-150, F-Series Super Duty, Transit Connect	B	4 3 2 1	GND CAN2- CAN2+ VPWR

Powertrain Control Module-B (PCM-B) Connector

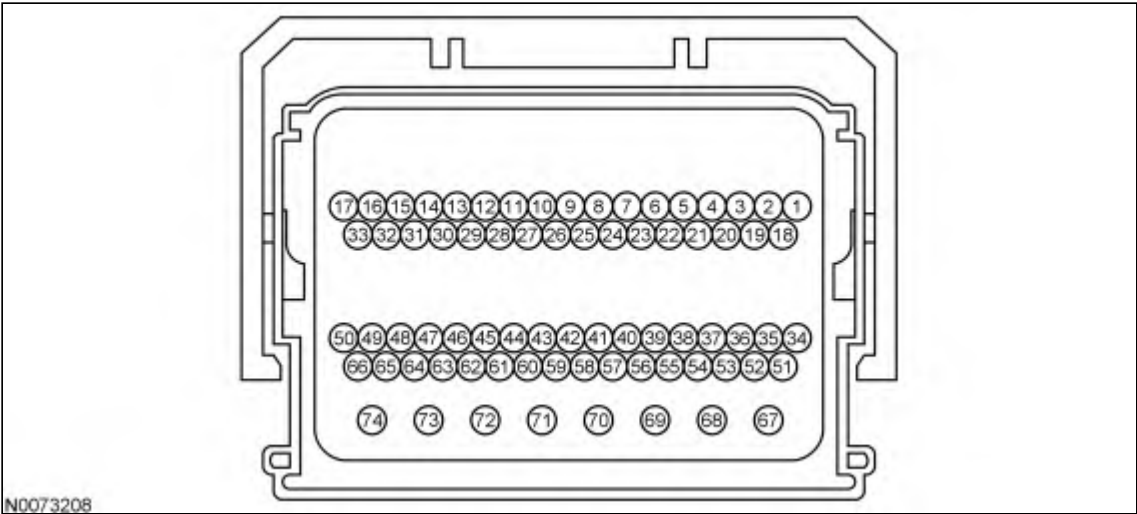
A



B

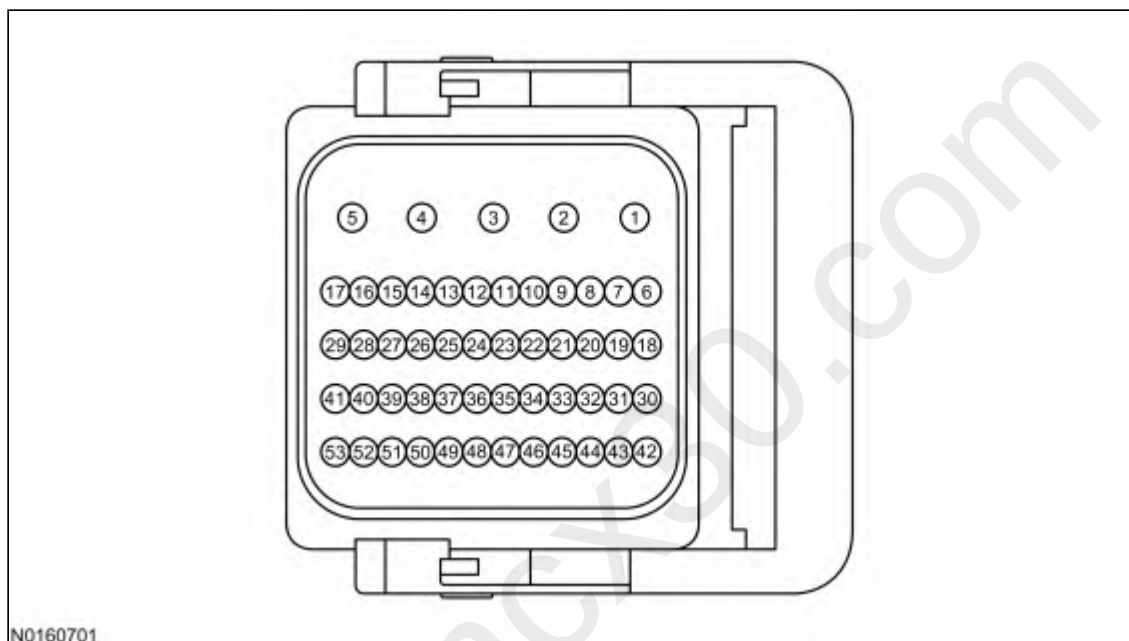


C



Vehicle	Connector	Pin	Circuit
F-Series Super Duty	A	15 14	CAN2- CAN2+
Transit Connect	B	84 65	CAN2- CAN2+
All other vehicles	C	39 56	CAN2- CAN2+

Powertrain Control Module-T (PCM-T) Connector



Pin	Circuit
36	CAN2- (Controller Area Network 2)
35	CAN2+ (Controller Area Network 2)

RD1 CHECK FOR DTCS

Are DTCs P0133, P0139, P0140, P06EA, P06EB, P123E, P123F, P207F, P20EE, P2200, P2201, P2204, P2209, P220A, P220B, P220E, P220F, P225A, P225B, P229E, P229F, P22A2, P22A7, P249C, P2A00, P2A01, U029D, U029E, U059E, U05A1 or U05A2 present?

Yes	For F-150 or Transit Connect with DTC P2201, GO to RD28. For all others with DTC P2201, GO to RD2. For DTCs P06EA or P06EB, GO to RD4. For DTCs P2200, P220E, P220F or P229E, GO to RD7. For DTCs P225A, P225B, U059E, U05A1 or U05A2, GO to RD8. For all others, GO to RD5.
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No	RETURN to Section 3, Symptom Charts for further direction.
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RD2 REVIEW THE FREEZE FRAME DATA

Note: Refer to the scan tool instruction manual to retrieve the freeze frame information.

- Access the freeze frame data (if available) and record the DTC conditions.

Is the recorded engine speed greater than 700 RPM and the recorded vehicle speed greater than 8 KM/H (5 MPH) when the DTC set?

Yes	INSTALL a new NOx11 sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Nitrogen Oxide Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). CARRY OUT the Drive Cycle Procedure. REFER to Section 2, Drive Cycles. Clear the PCM DTCs. REPEAT the self-test.
No	GO to RD3 .

RD3 CHECK THE VEHICLE REPAIR HISTORY

Note: DTC P2201 may set within 8047 km (5000 miles) of a selective catalytic reduction (SCR) catalyst replacement if the Reset And Clear The Specified Function Oxidation Catalyst is not completed.

- Check the vehicle repair history.

Does the vehicle repair history indicate an SCR catalyst replacement within the previous 8047 km (5000 miles)?

Yes	CARRY OUT the Reset And Clear The Specified Function Oxidation Catalyst on the scan tool. Refer to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). CARRY OUT the Reset And Clear The Specified Function SCR Parameter Reset on the scan tool. Refer to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). CARRY OUT the Diesel Particulate Regeneration System DPF Parameter Reset function on the scan tool. Refer to Section 2, Resetting The Diesel Particulate Filter Parameter. Drive the vehicle for greater than 16 km (10 miles) at a steady state speed. Clear the PCM DTCs. REPEAT the self-test.
No	GO to RD7 .

RD4 COMPARE THE AMBIENT AIR TEMPERATURE (AAT) SENSOR, THE EXHAUST GAS TEMPERATURE (EGT) SENSOR AND THE INTAKE AIR TEMPERATURE (IAT) SENSOR PID VALUES

Note: Allow the exhaust system temperature to stabilize to the ambient temperature for a minimum of 6 hours.

- Ignition ON, engine OFF.
- For Transit or Transit Connect,
- Access the PCM and monitor the AAT (TEMP), EGT12 (TEMP), EGT13 (TEMP) and IAT (TEMP) PIDs.
- For all others,
- Access the PCM and monitor the AAT (TEMP), EGT12 (TEMP), EGT14 (TEMP) and IAT11 (TEMP) PIDs.

Are the PID readings within 30°C (54°F) of ambient temperature?

Yes	GO to RD5 .
No	REFER to the appropriate pinpoint test to DIAGNOSE the sensor that is out of range. For the AAT sensor, GO to Pinpoint Test FA.

For the EGT12 sensor, the EGT13 sensor or the EGT14 sensor, GO to Pinpoint Test RC . For the IAT sensor, GO to Pinpoint Test E .

RD5 CHECK FOR OTHER DTCS

Are any DTCs present other than P0133, P0139, P0140, P06EA, P06EB, P123E, P123F, P207F, P20EE, P2204, P2209, P220A, P220B, P229F, P22A2, P22A7, P249C, P2A00, P2A01, U029D or U029E?

Yes	DISREGARD the current diagnostic trouble code (DTC) at this time. DIAGNOSE the next DTC. GO to Section 4, Diagnostic Trouble Code (DTC) Charts and Descriptions .
No	For DTCs P06EA, P06EB, P123E, P123F, U029D or U029E, GO to RD8 . For DTCs P207F or P20EE, GO to RD6 . For all others, GO to RD7 .

RD6 CHECK THE REDUCTANT CONCENTRATION

- Access the PCM and monitor the DEF_CONC (PER) PID.

Is the reductant concentration between 28 - 35%?

Yes	GO to RD7 .
No	Drain and refill the reductant tank with new reductant. CARRY OUT the Selective Catalytic Reduction (SCR) System Procedure. Refer to Section 2, Drive Cycles . Drive the vehicle for greater than 16 km (10 miles) at a steady state speed. Clear the PCM DTCs. REPEAT the self-test.

RD7 CHECK FOR A SOURCE OF POTENTIAL CONTAMINATION

- Investigate the following items as potential sources of NOx11 sensor and NOx12 sensor contamination:
 - use of unapproved silicon sealers
 - excessive oil consumption
 - coolant leaking internally in the engine
 - use of unapproved cleaning agents

Is a concern present?

Yes	For DTCs P207F or P20EE, REPAIR the source of the contamination. CHANGE the engine oil and oil filter. INSTALL a new NOx11 sensor and a new NOx12 sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Nitrogen Oxide Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM) . CARRY OUT the Selective Catalytic Reduction (SCR) System Procedure. REFER to Section 2, Drive Cycles . Clear the PCM DTCs. REPEAT the self-test. For DTCs P2204 or P22A2, REPAIR the source of the contamination. CHANGE the engine oil and oil filter. CARRY OUT the Selective Catalytic Reduction (SCR) System Procedure. REFER to Section 2, Drive Cycles . Clear the PCM DTCs. REPEAT the self-test. For all others, REPAIR the source of the contamination. CHANGE the engine oil and oil filter. Clear the PCM DTCs. REPEAT the self-test.
No	GO to RD8 .

RD8 CARRY OUT A VISUAL INSPECTION

- Visually inspect the NOx11 module, the NOx12 module, the NOx11 sensor, and the NOx12 sensor for the following:
 - signs of excessive heat
 - damaged wiring harness or connectors
 - correct harness routing
 - correct connections
 - correct ground circuit connections to the frame
- Visually inspect the exhaust system for the following:
 - exhaust leaks at flanges and gaskets
 - exhaust leaks at the NOx11 and NOx12 sensors
 - damage
 - restrictions or blockage
 - correct connections
- Visually inspect the vehicle for aftermarket accessories or aftermarket performance modifications. Refer to Section 1, [Engine Control \(EC\) System](#), Modifications to OBD Vehicles.
- Check the intake air system for the following:
 - leaks
 - damage
 - correct connections
 - restrictions or blockage
 - water intrusion
- Check the air filter for the following:
 - restrictions or blockage
 - damage
 - correct installation
 - oil coating
- Check the charge air cooler system for the following:
 - leaks
 - restrictions
 - low secondary cooling system coolant level
- Visually inspect the intake manifold gasket for signs of leaks.
- check for a correctly installed oil fill cap, oil level indicator and oil level indicator tube.
- Check for an exhaust gas recirculation (EGR) valve gasket leak to the EGR cooler.
- Check the crankcase ventilation system for leaks and restrictions.
- Inspect for radio frequency interference or electromagnetic interference.

Is a concern present?

Yes	For DTCs P123E, P123F, P207F, P2204 or P22A2, REPAIR as necessary. CARRY OUT the Selective Catalytic Reduction (SCR) System Procedure. REFER to Section 2, Drive Cycles . Clear the PCM DTCs. REPEAT the self-test. For all others, REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	For Transit Connect, GO to RD9 . For all others with DTCs P207F or P20EE, GO to RD21 . For all others with DTC P2201, GO to RD16 . For all others, GO to RD9 .

RD9 CHECK THE VOLTAGE TO NOX MODULE

Note: Only diagnose the suspect NOx module indicated by the DTC.

- For NOx11 module,
- NOx11 Module connector disconnected.
- Ignition ON, engine OFF.
- Measure the voltage between:

(+) NOx11 Module Connector, Harness Side	(-)
VPWR	Ground

- For NOx12 module,
- NOx12 Module connector disconnected.
- Ignition ON, engine OFF.
- Measure the voltage between:

(+) NOx12 Module Connector, Harness Side	(-)
VPWR	Ground

Is the voltage greater than 10.5 V?

Yes	For DTCs P220A or P220B, GO to RD14 . For all others, GO to RD10 .
No	For DTCs P123E, P123F, P2204 or P22A2, REPAIR the open circuit. CARRY OUT the Selective Catalytic Reduction (SCR) System Procedure. REFER to Section 2, Drive Cycles . Clear the PCM DTCs. REPEAT the self-test. For all others, REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test.

RD10 CHECK THE NOX MODULE CIRCUITS FOR AN OPEN

Note: Only diagnose the suspect NOx module indicated by the DTC.

- Ignition OFF.
- PCM-B connector disconnected.
- For Transit with NOx11 module DTCs,
- Measure the resistance between:

(+) NOx11 Module Connector, Harness Side	(-) PCM-T Connector, Harness Side
CAN2+	CAN2+ - Pin 35
CAN2-	CAN2- - Pin 36

- For Transit with NOx12 module DTCs,
- Measure the resistance between:

(+) NOx12 Module Connector, Harness Side	(-) PCM-T Connector, Harness Side
CAN2+	CAN2+ - Pin 35
CAN2-	CAN2- - Pin 36

- For all others with NOx11 module DTCs,
- Measure the resistance between:

(+) NOx11 Module Connector, Harness Side	(-) PCM-B Connector, Harness Side
CAN2+	CAN2+
CAN2-	CAN2-

- For all others with NOx12 module DTCs,
- Measure the resistance between:

(+) NOx12 Module Connector, Harness Side	(-) PCM-B Connector, Harness Side
CAN2+	CAN2+
CAN2-	CAN2-

Are the resistances less than 5 ohms?

Yes	GO to RD11 .
No	For DTCs P123E, P123F, P2204 or P22A2, REPAIR the open circuit. CARRY OUT the Selective Catalytic Reduction (SCR) System Procedure. REFER to Section 2, Drive Cycles . Clear the PCM DTCs. REPEAT the self-test. For all others, REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test.

RD11 CHECK THE VPWR AND GND CIRCUITS FOR EXCESSIVE RESISTANCE

Note: Some module power and ground input circuits may be very sensitive to voltage drop due to increased internal circuit resistance. REFER to Section 2, [Intermittent Diagnostic Techniques](#) for further information about power supply circuit load testing.

- For F-Series Super Duty,
- BJB-A connector disconnected.
- Measure the resistance between:

(+) NOx11 Module Connector, Harness Side	(-) BJB-A Connector, Harness Side
VPWR	VPWR

- For all others,
- Measure the resistance between:

(+) NOx11 Module Connector, Harness Side	(-) PCM Power Relay Connector, Harness Side
VPWR	VPWR

- Measure the resistance between:

(+) NOx11 Module Connector, Harness Side	(-) Vehicle Battery
GND	Negative terminal

- For F-Series Super Duty,
- Measure the resistance between:

(+) NOx12 Module Connector, Harness Side	(-) BJB-A Connector, Harness Side
VPWR	VPWR

- For all others,
- Measure the resistance between:

(+) NOx12 Module Connector, Harness Side	(-) PCM Power Relay Connector, Harness Side
VPWR	VPWR

- Measure the resistance between:

(+) NOx12 Module Connector, Harness Side	(-) Vehicle Battery
GND	Negative terminal

Are the resistances less than 5 ohms?

Yes	For DTCs P225A or P225B, GO to RD13 . For DTCs P0133, P0139, P2200, P220E, P220F, P229E, P229F, P2A00 or P2A01, INSTALL a new NOx sensor in question. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Nitrogen Oxide Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM) . GO to RD12 . For all others, GO to RD14 .
No	REPAIR the excessive circuit resistance. Clear the PCM DTCs. REPEAT the self-test.

RD12 CARRY OUT A DRIVE CYCLE

- Carry out the Drive Cycle Procedure. Refer to Section 2, [Drive Cycles](#).
- Carry out the PCM self-test.

Are any DTCs present?

Yes	For DTCs P2200 or P229E, GO to RD14 . For all others, DISREGARD the current diagnostic trouble code (DTC) at this time. DIAGNOSE the next DTC. GO to Section 4, Diagnostic Trouble Code (DTC) Charts and Descriptions to continue diagnosis.
No	The system is operating correctly at this time.

RD13 CHECK THE NOX MODULE FOR THE LATEST CALIBRATION

Note: Do not replace the NOx module unless instructed to do so in this pinpoint test.

- PCM-B connector connected.
- For DTC P225A,

- NOx11 Module connector connected.
- Program the NOx11 module to the latest calibration. REFER to Section 2, [Flash Electrically Erasable Programmable Read Only Memory \(EEPROM\)](#).
- Carry out the PCM self-test.
- For DTC P225B,
- NOx12 Module connector connected.
- Program the NOx12 module to the latest calibration. REFER to Section 2, [Flash Electrically Erasable Programmable Read Only Memory \(EEPROM\)](#).
- Carry out the PCM self-test.

Are DTCs P225A or P225B present?

Yes	INSTALL a new NOx module in question. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Nitrogen Oxide Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). Clear the PCM DTCs. REPEAT the self-test.
No	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

RD14 CHECK FOR CORRECT NOX MODULE OPERATION

- For DTCs P06EA, P123E, P2200, P2204, P2209, P220A, P249C, U029D, U059E or U05A1,
- Disconnect all the NOx11 module connectors.
- Visually inspect for:
 - pushed out pins
 - corrosion
- Connect all the NOx11 module connectors and make sure they seat correctly.
- For all others,
- Disconnect all the NOx12 module connectors.
- Visually inspect for:
 - pushed out pins
 - corrosion
- Connect all the NOx12 module connectors and make sure they seat correctly.

Is the concern still present?

Yes	For DTCs P123E, P123F, P2204 or P22A2, INSTALL a new NOx module in question. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Nitrogen Oxide Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). CARRY OUT the Selective Catalytic Reduction (SCR) System Procedure. REFER to Section 2, Drive Cycles. Clear the PCM DTCs. REPEAT the self-test. For all others, INSTALL a new NOx module in question. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Nitrogen Oxide Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). GO to RD15.
No	For DTCs P123E, P123F, P2204 or P22A2, the system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. CARRY OUT the Selective Catalytic Reduction (SCR) System Procedure. REFER to Section 2, Drive Cycles. Clear the PCM DTCs. REPEAT the self-test.

For all others, the system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
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RD15 CARRY OUT THE DIESEL PARTICULATE FILTER MANUAL REGENERATION WITH THE SCAN TOOL

- Carry out the Diesel Particulate Filter Manual Regeneration with the scan tool. Refer to Section 2, [Scan Tool Setup and Functionality](#).
- Carry out the Drive Cycle Procedure. Refer to Section 2, [Drive Cycles](#).
- Carry out the PCM self-test.

Are DTCs P0140, P2209 or P22A7 present?

Yes	For DTC P2209, INSTALL a new NOx11 sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Nitrogen Oxide Sensor 1 on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). Clear the PCM DTCs. REPEAT the self-test. For all others, INSTALL a new NOx12 sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Nitrogen Oxide Sensor 2 on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). Clear the PCM DTCs. REPEAT the self-test.
No	The system is operating correctly at this time.

RD16 COMPARE THE AAT, CACT, ECT AND EGT12 PID VALUES

Note: If any EGT sensor connector has been disconnected during testing, with the ignition ON and the engine OFF, connect the EGT sensor. Turn the ignition OFF for 30 seconds before attempting to start the vehicle. Do not crank or start the engine until the ignition has been turned OFF for a minimum of 30 seconds. Failure to do so may result in a 60 minute no crank, no start condition and a failure mode effects management (FME) condition. Carry out the EGT Engine Protection Reset on the scan tool. Refer to Section 2, [Clear The Continuous Diagnostic Trouble Codes \(DTCs\) And Reset The Emission Monitors Information in The Powertrain Control Module \(PCM\)](#).

- Ignition OFF.
- Allow the exhaust system temperature to stabilize to the ambient temperature for a minimum of 6 hours.
- Ignition ON, engine OFF.
- Access the PCM and monitor the AAT (TEMP), CAC_T (TEMP), ECT (TEMP) and EGT12 (TEMP) PIDs.

Are the PID values within 10°C (18°F) of the ambient temperature?

Yes	GO to RD17 .
No	REFER to the appropriate pinpoint test to DIAGNOSE the sensor that is out of range. For the AAT sensor, GO to Pinpoint Test FA. For the CACT sensor, GO to Pinpoint Test FB. For the ECT sensor, GO to Pinpoint Test K. For the EGT12 sensor, GO to Pinpoint Test RC.

RD17 CHECK FOR A BIASED PRESSURE SENSOR

Note: All PIDs may not be available on all vehicles.

- Ignition ON, engine OFF.
- Access the PCM and monitor the BARO (PRESS), EBP (PRESS) and MAP (PRESS) PIDs.

Is the MAP PID value within 4.5 kPa (0.65 psi) of the BARO PID value (Transit), or is the EBP PID value within 7.5

kPa (1.09 psi) and the MAP PID value within 4.5 kPa (0.65 psi) of the BARO PID value (all others)?

Yes	GO to RD18 .
No	REFER to the appropriate pinpoint test to DIAGNOSE the sensor that is out of range. For the EP sensor, GO to Pinpoint Test X . For the MAP sensor, GO to Pinpoint Test E . For the BARO sensor, Clear the PCM DTCs. REPEAT the self-test. If the concern is still present, GO to RD29 .

RD18 CHECK FOR A BIASED FRP SENSOR

Note: The ignition must be OFF for a minimum of 15 seconds to allow the fuel rail pressure to bleed off.

- Ignition ON, engine OFF.
- For Transit,
- Access the PCM and monitor the FRP_A (PRESS) PID.
- For all others,
- Access the PCM and monitor the FRP (PRESS) PID.

Is the PID value between 0 kPa (0 psi) and 3447 kPa (500 psi)?

Yes	GO to RD19 .
No	GO to Pinpoint Test MB .

RD19 CHECK THE MAF SENSOR

Note: The engine coolant temperature must be greater than 70°C (158°F) before completing this step.

- Ignition ON, engine running.
- Access the PCM and control the EGRVPDES (PER) PID.
- Command the EGRVPDES PID to the minimum value.
- Access the PCM and control the EGRTD_CMD (PER) PID.
- Command the EGRTD_CMD PID to 0%.
- Access the PCM and control the VGTDC (PER) PID.
- Command the VGTDC PID to 0%.
- Access the PCM and monitor the MAF_HZ (FREQ) PID.
- Monitor the MAF_HZ PID at idle and record the value.
- Access the PCM and control the RPMDSD (RPM) PID.
- Increase the engine speed to 1,200 RPM.
- Record the MAF_HZ PID value.
- Increase the engine speed to 2,000 RPM.
- Record the MAF_HZ PID value.
- Access the PCM and monitor the MAFLRN_IDLE (NUM) PID.
- Access the PCM and monitor the MAFLRN_AIDLE (NUM) PID.
- Record the PID values.

Is the MAF_HZ PID value between 3.5 - 3.8 kHz at idle, between 4.1 - 4.4 kHz at 1,200 RPM and between 5.1 - 5.4 kHz at 2,000 RPM (Transit), or is the MAF_HZ PID value between 3.5 - 3.9 kHz at idle, between 4.5 - 5.4 kHz at 1,200 RPM and between 5.8 - 6.3 kHz at 2,000 RPM (all others)?

Yes	GO to RD20 .
No	For F-650 / F-750 or Transit, INSTALL a new MAF/IAT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function MAF Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM) . Clear the PCM DTCs. REPEAT the self-test.

For all others, with MAFLRN_IDLE or MAFLRN_AIDLE PID values between 0.00 and 0.12, INSTALL a new MAF/IAT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls.

Clear the PCM DTCs. REPEAT the self-test.

For all others, with MAFLRN_IDLE or MAFLRN_AIDLE PID values less than 0.00 or greater than 0.12, INSTALL a new MAF/IAT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls.

CARRY OUT the Reset And Clear The Specified Function MAF Sensor on the scan tool. REFER to Section 2, [Clear The Continuous Diagnostic Trouble Codes \(DTCs\) And Reset The Emission Monitors Information in The Powertrain Control Module \(PCM\)](#).

Clear the PCM DTCs. REPEAT the self-test.

RD20 CHECK THE EGR VALVE RESPONSE TIME

Note: All PIDs may not be available on all vehicles.

- Ignition ON, engine OFF.
- Access the PCM and monitor the EGR_A_ACT (PER) PID.
- Access the PCM and control the EGRVPDES (PER) PID.
- Command the EGRVPDES PID to the minimum value.
- Access the PCM and monitor the MAFLRN_IDLE (NUM) PID.
- Access the PCM and monitor the MAFLRN_AIDLE (NUM) PID.
- Record the PID values.

Does the EGR valve position PID value follow the commanded EGR PID value within 0.2 seconds?

Yes	GO to RD24 .
No	For F-150 with MAFLRN_AIDLE values between -0.06 and 0.06, INSTALL a new EGR valve. REFER to the Workshop Manual Section 303-08, Engine Emission Control. Clear the PCM DTCs. REPEAT the self-test. For F-150 with MAFLRN_AIDLE values less than -0.06 or greater than 0.06, INSTALL a new EGR valve. REFER to the Workshop Manual Section 303-08, Engine Emission Control. CARRY OUT the Reset And Clear The Specified Function MAF Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). Clear the PCM DTCs. REPEAT the self-test. For F-650 / F-750 or Transit, INSTALL a new EGR valve. REFER to the Workshop Manual Section 303-08, Engine Emission Controls. CARRY OUT the Reset And Clear The Specified Function MAF Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). Clear the PCM DTCs. REPEAT the self-test. For all others, with MAFLRN_IDLE or MAFLRN_AIDLE PID values between 0.00 and 0.12, INSTALL a new EGR valve. REFER to the Workshop Manual Section 303-08, Engine Emission Controls. Clear the PCM DTCs. REPEAT the self-test. For all others, with MAFLRN_IDLE or MAFLRN_AIDLE PID values less the 0.00 or greater than 0.12, INSTALL a new EGR valve. REFER to the Workshop Manual Section 303-08, Engine Emission Controls. CARRY OUT the Reset And Clear The Specified Function MAF Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). Clear the PCM DTCs. REPEAT the self-test.

RD21 CHECK THE REDUCTANT DOSING MEASUREMENT

Note: Verify there are no low diesel exhaust fluid warnings on the message center. Fill the reductant tank as needed.

Note: Check for external leaks during the SCR Dosing Measurement Test. Repair as necessary.

Note: Check the reductant injector spray pattern during the SCR Dosing Measurement Test. Replace the reductant injector if the spray pattern is not uniform.

Note: During the SCR Dosing Measurement Test the REDUCT_PMP_DC PID value may cycle above 50%.

Note: The quantity of reductant dispensed during the reductant injector test should be 40-50 ml (1.35-1.69 oz).

- Ignition OFF.
- Remove the reductant injector from the SCR catalyst. Leave the electrical connector and reductant pressure line connected.
- Install the Tool, 5.4L Injector Test 310-190 or equivalent to the reductant injector.
- Access the PCM and monitor the REDUCT_TNK_P (PRESS) PID.
- Access the PCM and monitor the REDUCT_PMP_DC (PER) PID.
- Carry out the SCR Dosing Measurement Test on the scan tool.
- Record the REDUCT_TNK_P (PRESS) PID value during the test.
- Record the amount of reductant fluid generated by the reductant injector.

Is the volume of reductant fluid dispensed during the test between 40-50 ml (1.35-1.69 oz)?

Yes	GO to RD22 .
No	For REDUCT_TNK_P (PRESS) PID value greater than 70 PSI (483 kPa) and less than 75 PSI (517 kPa), INSTALL a new Reductant Injector solenoid. REFER to the Workshop Manual Section 303-08, Engine Emission Controls. CARRY OUT the Selective Catalytic Reduction (SCR) System Procedure. REFER to Section 2, Drive Cycles. Drive the vehicle for greater than 16 km (10 miles) at a steady state speed. Clear the PCM DTCs. REPEAT the self-test. For all others, INSTALL a new Reductant Pump assembly. REFER to the Workshop Manual Section 303-08, Engine Emission Controls. CARRY OUT the Selective Catalytic Reduction (SCR) System Procedure. REFER to Section 2, Drive Cycles. Drive the vehicle for greater than 16 km (10 miles) at a steady state speed. Clear the PCM DTCs. REPEAT the self-test.

RD22 CARRY OUT THE SELECTIVE CATALYST REDUCTION (SCR) VISUAL LEAK TEST WITH THE IDS

Note: Verify there are no low diesel exhaust fluid warnings on the message center.

- Fill the reductant tank as needed.
- Ignition OFF.
- Remove the reductant injector from the SCR catalyst. Leave the electrical connector and reductant pressure line connected.
- Install the Tool, 5.4L Injector Test 310-190 or equivalent to the reductant injector.
- Carry out the SCR visual leak test on the scan tool.

Is a concern present?

Yes	INSTALL a new Reductant Injector solenoid. REFER to the Workshop Manual Section 303-08, Engine Emission Controls. CARRY OUT the Selective Catalytic Reduction (SCR) System Procedure. Refer to Section 2, Drive Cycles. Drive the vehicle for greater than 16 km (10 miles) at a steady state speed. Clear the PCM DTCs. REPEAT the self-test.
No	GO to RD23 .

RD23 CHECK THE PID READING

- Ignition ON, engine OFF.
- Access the PCM and monitor the SCR_AMMONIA (MASS) PID.

Is the PID value greater than 0.08 oz (2.3 grams) (Transit) or is the PID value greater than 0.14 oz (4 grams) (F-Series Super Duty narrow frame or F-650 / F-750) or is the PID value greater than 0.17 oz (5 grams) (all others)?

Yes	For Transit, CARRY OUT the Selective Catalytic Reduction (SCR) System SCR Parameter Reset procedure. REFER to Section 1, Engine Control Components, Selective Catalytic Reduction (SCR) Catalyst for additional information. CARRY OUT the Diesel Particulate Regeneration System DPF Manual Regeneration procedure. REFER to Section 1, Engine Control Components, Selective Catalytic Reduction (SCR) Catalyst for additional information. GO to RD25. For all others, CARRY OUT the Selective Catalytic Reduction (SCR) System SCR Parameter Reset procedure. REFER to Section 1, Engine Control Components, Selective Catalytic Reduction (SCR) Catalyst for additional information. CARRY OUT the Diesel Particulate Regeneration System DPF Manual Regeneration procedure. REFER to Section 1, Engine Control Components, Selective Catalytic Reduction (SCR) Catalyst for additional information. GO to RD24.
No	For Transit, GO to RD25. For all others, GO to RD24.

RD24 CHECK THE EGR VALVE WITH THE EGR BLOCKED AND UNBLOCKED

NOTICE: Use care when inserting the putty knife to avoid damage to the seal and sealing surface of the manifold. Do not pry or force the putty knife into the opening. Remove the 2 inch (5cm) flexible putty knife and connect the EGR tube at the completion of this step.

Note: All PIDs may not be available on all vehicles.

Note: Additional DTCs may set during the use of output state control (OSC). Clear all the PCM and the transmission control module (TCM) DTCs after the diagnostics have been completed. Repeat the self-test to verify all the DTCs have been cleared.

Note: Verify the engine coolant temperature (ECT) is greater than 80°C (176°F) before testing.

- Ignition ON, engine running.
- Access the PCM and control the RPMDSD (RPM) PID.
- Command the engine speed to 1,500 RPM.
- Access the PCM and control the VGTDC (PER) PID.
- Command the VGTDC PID to 80%.
- Access the PCM and monitor the NOX11 (NUM) PID.
- For F650 / F750 and Transit,
- Access the PCM and control the EGRVPDES (PER) PID.
- Command the EGRVPDES PID to 0%.
- For all others,
- Access the PCM and control the EGR_A_CMD (PER) PID.
- Command the EGR_A_CMD PID to 0%.
- Wait 30 seconds.
- Record the NOX11 (NUM) PID value.
- Ignition OFF.
- Loosen the EGR tube to intake manifold bolts. Pull back the EGR tube to make an opening. Refer to the Workshop manual Section 303-08, Engine Emission Control.
- Insert a 2 inch (5cm) flexible putty knife into the opening between the EGR gasket and the intake manifold to block the EGR flow to the intake manifold.
- Tighten the EGR tube to the intake manifold bolts to the specified torque. Refer to the Workshop Manual Section 303-08, Engine Emission Control.
- Ignition ON, engine running.
- Repeat this step with the EGR tube blocked to record the NOX11 (PPM) PID.
- Subtract the unblocked EGR NOX11 PID value from the blocked EGR NOX11 PID value.

Is the difference between the NOX11 PID values less than 60 PPM?

Yes	GO to RD25 .
No	For F-150 with MAFLRN_AIDLE values between -0.06 and 0.06, INSTALL a new EGR valve. REFER to the Workshop Manual Section 303-08, Engine Emission Control. CARRY OUT the Drive Cycle procedure. REFER to Section 2, Drive Cycles. Clear the PCM DTCs. REPEAT the self-test. For F-150 with MAFLRN_AIDLE values less than -0.06 or greater than 0.06, INSTALL a new EGR valve. REFER to the Workshop Manual Section 303-08, Engine Emission Control. CARRY OUT the Reset And Clear The Specified Function MAF Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). CARRY OUT the Drive Cycle procedure. REFER to Section 2, Drive Cycles. Clear the PCM DTCs. REPEAT the self-test. For F-650 / F-750, INSTALL a new EGR valve. REFER to the Workshop Manual Section 303-08, Electronic Emission Controls. CARRY OUT the Reset And Clear The Specified Function MAF Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). CARRY OUT the Drive Cycle procedure. REFER to Section 2, Drive Cycles. Clear the PCM DTCs. REPEAT the self-test. For all others, with MAFLRN_IDLE or MAFLRN_AIDLE PID values between 0.00 and 0.12, INSTALL a new EGR valve. REFER to the Workshop Manual Section 303-08, Electronic Emission Controls. CARRY OUT the Drive Cycle procedure. REFER to Section 2, Drive Cycles. Clear the PCM DTCs. REPEAT the self-test. For all others, with MAFLRN_IDLE or MAFLRN_AIDLE PID values less than 0.00 or greater than 0.12, INSTALL a new EGR valve. REFER to the Workshop Manual Section 303-08, Electronic Emission Controls. CARRY OUT the Reset And Clear The Specified Function MAF Sensor on the scan tool. REFER to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). CARRY OUT the Drive Cycle procedure. REFER to Section 2, Drive Cycles. Clear the PCM DTCs. REPEAT the self-test.

RD25 CHECK THE NOX11 SENSOR

Note: For F-Series Super Duty narrow frame, if the NOx11 PID is greater than 100 PPM turn the ignition OFF and wait 3 to 5 minutes and then start the engine.

- Ignition ON, engine running.
- Access the PCM and monitor the NOX11 (NUM) PID.
- Access the PCM and monitor the ECT1 (TEMP) PID.
- Access the PCM and monitor the EGT12 (TEMP) PID.
- Increase the engine speed until the ECT PID value is greater than 80°C (176°F) and the EGT12 PID value is greater than 200°C (392°F) for 2 minutes.
- Allow the engine to idle for 2 minutes.
- Record the NOX11 (NUM) PID value.
- Access the PCM and control the VGTDC (PER) PID.
- Command the VGTDC PID to 80%.
- For F-650 / F-750 or Transit,
- Access the PCM and control the EGRVPDES (PER) PID.
- Command the EGRVPDES PID to 0%.
- For all others,
- Access the PCM and control the EGR_A_CMD (PER) PID.
- Command the EGR_A_CMD PID to 0%.
- Access the PCM and control the FRP_DSD (PRESS) PID.
- Command the FRP_DSD PID between 450-550 bar (6500-8000 psi or 45000-55000 kPa).
- Wait 1 minute.
- Record the NOX11 (NUM) PID value.

Is the difference between the NOX11 PID values greater than 30 PPM (transit) or 100 PPM (all others)?

Yes	For DTCs P207F or P20EE, GO to RD26 . For all others, the system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.
No	INSTALL a new NOx11 sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Nitrogen Oxide Sensor on the scan tool. Refer to section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM) . Clear the PCM DTCs. REPEAT the self-test.

RD26 CHECK THE NOX12 SENSOR OPERATION

Note: Verify the ambient air temperature (AAT) PID is greater than 4°C (40°F) before completing this step.

Note: The NOx sensors may read zero while the exhaust system is cooling off. Do not replace any NOx sensors unless instructed.

- Ignition ON, engine running.
- Access the PCM and monitor the NOX11 (NUM) PID.
- Access the PCM and monitor the NOX12 (NUM) PID.
- Access the PCM and monitor the ECT (TEMP) PID.
- Access the PCM and monitor the EGT12 (TEMP) PID.
- Increase the engine speed until the ECT PID value is greater than 80°C (176°F) and the EGT12 PID value is greater than 230°C (450°F) for 2 minutes.
- Allow the engine to idle and wait until the EGT12 PID is less than 125°C (257°F).
- Record the NOx11 PID and the NOx12 PID values.
- Refer to the video.

Is the NOx12 PID value within 5 PPM greater than or within 40 PPM less than the NOx11 PID value?

Yes	GO to RD27 .
No	INSTALL a new NOx12 sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Nitrogen Oxide Sensor on the scan tool. Refer to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM) . CARRY OUT the Drive Cycle Procedure. Refer to Section 2, Drive Cycles . Clear the PCM DTCs. REPEAT the self-test.

RD27 DRIVE THE VEHICLE

Note: Verify the ambient air temperature (AAT) PID is greater than 0°C (32°F) before driving the vehicle.

Note: The minimum NOx Catalyst Conversion Efficiency value may change based on exhaust temperature and exhaust flow rate.

- Ignition ON, engine running.
- Access the PCM and monitor the AAT (TEMP) PID.
- Access the PCM and monitor the EGT12 (TEMP) PID.
- Access the PCM and monitor the VSS (SPD) PID.
- Access the PCM and monitor the NOX12 (NUM) PID.
- Drive the vehicle at a steady state speed between 55-75 MPH until the following occurs:
 - the NOx12 PID value is greater than 0 and changing.
 - the EGT12 PID value is between 235 - 270°C (455 - 518°F) for 40 km (25 miles).
- Access the PCM and monitor the OBD Test Modes, Mode 6 On-Board Test Results, NOx Catalyst Conversion Efficiency data.

Is the actual NOx Catalyst Conversion Efficiency value greater than or equal to the minimum NOx Catalyst

Conversion Efficiency value plus 3%?

Yes	The system is operating correctly at this time.
No	INSTALL a new Selective Catalytic Reduction (SCR) Catalyst. REFER to the Workshop Manual Section 309-00, Exhaust System. CARRY OUT the Reset And Clear The Specified Function Oxidation Catalyst on the scan tool. Refer to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). CARRY OUT the Reset And Clear The Specified Function SCR Parameter Reset on the scan tool. Refer to Section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). CARRY OUT the Diesel Particulate Regeneration System DPF Parameter Reset function on the scan tool. Refer to Section 2, Resetting The Diesel Particulate Filter Parameter. Drive the vehicle for greater than 16 km (10 miles) at a steady state speed. Clear the PCM DTCs. REPEAT the self-test.

RD28 CHECK FOR ADDITIONAL DTCS**Are any DTCs present other than P2201?**

Yes	DISREGARD the current diagnostic trouble code (DTC) at this time. DIAGNOSE the next DTC. GO to Section 4, Diagnostic Trouble Code (DTC) Charts and Descriptions .
No	INSTALL a new NOx11 module. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Nitrogen Oxide Sensor on the scan tool. Refer to section 2, Clear The Continuous Diagnostic Trouble Codes (DTCs) And Reset The Emission Monitors Information in The Powertrain Control Module (PCM). Clear the PCM DTCs. REPEAT the self-test.

RD29 CHECK FOR CORRECT PCM OPERATION

- Disconnect all the PCM connectors.
- Visually inspect for:
 - pushed out pins
 - corrosion
- Connect all the PCM connectors and make sure they seat correctly.
- Carry out the PCM self-test.
- Verify the concern is still present.

Is the concern still present?

Yes	INSTALL a new PCM. REFER to Section 2, Flash Electrically Erasable Programmable Read Only Memory (EEPROM). CLEAR the DTCs. REPEAT the self-test.
No	The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector.

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