

KA: Turbocharger System

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:

- turbocharger system performance
- turbocharger air leaks
- vacuum leaks
- turbocharger

KA1 PRELIMINARY DIAGNOSIS

Note: The presence of DTCs P0234, P0299, P1247, or P132B may indicate that the vehicle is operating in derate mode and may experience a loss of power.

Note: Diagnose and repair all circuit concern DTCs before diagnosing range, performance or flow concerns.

Note: Diagnose any BARO, EP, MAP and EGR DTCs before continuing with this test.

Are DTCs P0106, P0234, P0236, P0299, P1247, P1249, P124C, P132B, P2263, P226C or P259F present?

Yes	GO to KA2 .
No	For symptoms without DTCs, GO to KA2 . For all others, RETURN to Section 3, Symptom Charts for further direction.

KA2 TURBOCHARGER SYSTEM PERFORMANCE

Note: Visually inspect the vehicle for aftermarket accessories and performance modifications (air filter, exhaust system, intake system, performance chip, turbocharger). Refer to Section 1, [Engine Control \(EC\) System](#), Modifications to OBD Vehicles.

- Check for modifications to the electronic engine control (EEC) system.
- Visually inspect the intake air system for the following:
 - restricted or modified air filter or housing
 - water intrusion
 - worn gaskets between the mass air flow (MAF) sensor and the air cleaner assembly
 - exhaust gas recirculation (EGR) valve gasket leak to EGR cooler
 - verify the integrity of the crankcase ventilation system
 - incorrectly seated engine oil dipstick, tube or oil fill cap
 - leaks or restrictions in the charge air cooler (CAC)
 - low CAC coolant level
 - leaks, cracks, loose connections, punctures, or any other non-factory modifications
- Visually inspect the exhaust system for the following:
 - tailpipe modifications that increase or decrease the exhaust restriction
 - leaks, cracks, loose connections, punctures, or any other non-factory modifications

Is a concern present?

Yes	REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test.
No	GO to KA3 .

KA3 CHECK THE CHARGE AIR COOLER, AIR INTAKE AND EXHAUST SYSTEMS FOR LEAKS AND RESTRICTIONS

NOTICE: Strict observance of posted speed limits and attention to driving conditions are mandatory when carrying out the road test. Failure to follow these instructions may result in personal injury.

NOTICE: Pressure above 241 kPa (35 psi) can cause damage to system components. Regulate the shop air to 137.9 kPa (20 psi) before connecting to the system.

Note: Remember to reinstall the exhaust gas temperature bank 1 sensor 1 (EGT11) and the manifold absolute pressure (MAP) sensor (Transit) or the exhaust pressure (EP) sensor and the exhaust gas recirculation temperature bank 1, sensor 2 (EGRT12) (all others) and remove the plastic bag from the air filter at the completion of this step.

- Ignition OFF.
- For Transit and Transit Connect,
- Remove the EGT11 sensor.
- For all others,
- Remove the EP sensor.
- Use a suitable method to temporarily plug the exhaust pipe outlet.
- Connect the Rotunda Smoke Machine, Fuel Evaporative Emission System Tester 218-00001 (522) or equivalent to the exhaust system.
- Fill the exhaust system with smoke using the sensor fitting.
- Pressurize the exhaust system with 139 kPa (20 psi) regulated shop air.
- Check the exhaust system for leaks and restrictions.
- For Transit,
- Remove the MAP sensor.
- For Transit Connect,
- Remove the MAP/CACT sensor.
- For all others,
- Remove the EGRT12 sensor.
- Place the air filter in a plastic bag to prevent air flow out the intake port and reinstall it in the vehicle.
- Connect the smoke machine to the intake air system.
- Fill the intake air system with smoke using the sensor fitting.
- Pressurize the intake air system with 137.9 kPa (20 psi) regulated shop air.
- Check the intake air system for leaks and restrictions.

Is a concern present?

Yes	REPAIR or INSTALL a new component as necessary. CLEAR the PCM DTCs. ROAD TEST the vehicle and ACCELERATE the vehicle to achieve full boost. REPEAT the self-test. If symptom or DTC is still present, GO to KA4 .
No	For F-150, F-Series Super Duty, Transit and Transit Connect, GO to KA5 . For all others, GO to KA11 .

KA4 CARRY OUT A MANUAL REGENERATION OF THE DIESEL PARTICULATE FILTER (DPF)

NOTICE: Initiate a manual regeneration of the DPF only when the vehicle is on the ground with the area around the tailpipe free of people, obstructions, foreign material or other items. Always carry out the DPF manual regeneration procedure outside of a building.

NOTICE: For F-Series Super Duty, to prevent damage to the spare tire, lower it using the winch so that it rests on the floor. After the static regeneration procedure is completed, return the wheel back to its original position.

- Carry out the DPF manual regeneration with the scan tool.

Does the scan tool indicate that a manual regeneration cycle should be carried out?

Yes	CARRY OUT the diesel particulate filter manual regeneration with the scan tool. For F-150, F-Series Super Duty, Transit and Transit Connect, GO to KA5 . For all others, GO to KA11 .
No	For F-150, F-Series Super Duty, Transit and Transit Connect, GO to KA5 .

For all others, GO to [KA11](#).

KA5 CHECK FOR INPUT SENSOR BIAS

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

Is the MAP within 9.5 kPa (1.38 psi) of the BARO PID reading?

Yes	GO to KA6 .
No	For DTC P0106. INSTALL a new MAP sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. 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, INSTALL a new PCM. REFER to Section 2, Flash Electrically Erasable Programmable Read Only Memory (EEPROM) .

KA6 CHECK THE TURBOCHARGER OPERATION BOOST

- Ignition ON, engine running.
- Access the PCM and control the EGRVPDES (PER) PID.
- Command the EGRVPDES PID duty cycle to 0%.
- Access the PCM and control the EGRTP_CMD (PER) PID.
- Command the EGRTP_CMD PID to the minimum value.
- 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.
- Access the PCM and monitor the MAP (PRESS) PID.
- Command the VGTDC duty cycle to 100%.
- Command the VGTDC duty cycle to 0%.

Does the MAP pressure increase and decrease as the VGTDC PID is increased and decreased?

Yes	GO to KA10 .
No	GO to KA7 .

KA7 CHECK THE TURBOCHARGER ACTUATOR OPERATION WITH THE ENGINE OFF

- Ignition ON, engine OFF.
- Access the PCM and monitor the VGT_POS_V (VOLT) PID.
- Access the PCM and control the VGTDC (PER) PID.
- For F-Series Super Duty.
- Monitor the VGT_POS_V PID and compare the values to the turbocharger actuator position sensor table.

Turbocharger Actuator Position Sensor (F-Series Super Duty) (Approximate)

VGTDC PID	VGT_POS_V PID minimum	VGT_POS_V PID maximum
0%	1.1 (F-Series Super Duty)	1.3 (F-Series Super Duty)
100%	3.4 (F-Series Super Duty)	4.5 (F-Series Super Duty)

- For all others.
- Monitor the VGT_POS_V PID and compare the values to the turbocharger actuator position sensor table.

Turbocharger Actuator Position Sensor (Approximate)

VGTDc PID	VGT_POS_V PID minimum	VGT_POS_V PID maximum
0%	0.65 (F-150) 0.96 (all others)	0.85 (F-150) 1.04 (all others)
100%	4.15 (F-150) 3.92 (all others)	4.35 (F-150) 4.08 (all others)

Does the VGT_POS_V PID value approximately match the values in the turbocharger actuator position sensor table?

Yes	GO to KA8 .
No	GO to AK1 .

KA8 TURBOCHARGER COMPRESSOR WHEEL CHECK

- Inspect the turbocharger compressor wheel and housing for the following:
 - ability to spin freely
 - noise while spinning
 - damage to vanes on the compressor wheel
 - out of balance condition
 - debris in housing

Is a concern present?

Yes	REPAIR as necessary. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls, Component Tests.
No	GO to KA9 .

KA9 CHECK THE OPERATION OF THE TURBOCHARGER ACTUATOR

- Ignition ON, engine OFF.
- Access the PCM and control the VGTDc (PER) PID.
- Record the turbocharger actuator arm position.
- Command the VGTDc PID duty cycle to 100%.
- Record the turbocharger actuator arm position.

Does the turbocharger actuator arm change position when commanded?

Yes	Ignition OFF. For Transit Connect, GO to KA11 . For all others, GO to KA10 .
No	INSTALL a new Turbocharger Actuator. REFER to the Workshop Manual Section 303-04, Fuel Charging and 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.

KA10 CHECK THE TURBOCHARGER BOOST PRESSURE

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

- Allow the engine to idle at the normal operating temperature.
- Access the PCM and monitor the BARO (PRESS) and MAP (PRESS) PIDs.
- Access the PCM and control the EGRVPDES (PER) PID.
- Command the EGRVPDES PID to 0%.

- Access the PCM and control the EGRTP_CMD (PER) PID.
- Command the EGRTP_CMD PID to the minimum value.
- Access the PCM and control the RPMDS (RPM) PID.
- Command the engine speed to 2,000 RPM (F-150) or 1,800 RPM (all others).
- Access the PCM and control the VGTDC (PER) PID.
- Command the VGTDC PID duty cycle to 90% (F-150 and F-Series Super Duty) or 100% (all others).
- Record the MAP PID value.
- Command the VGTDC PID duty cycle to 0%.
- Record the MAP PID value.

Is the MAP PID reading within 5% of the BARO PID reading at 0% VGTDC duty cycle and does the MAP PID increase by greater than 27.5 kPa (4.0 psi) at 90% VGTDC duty cycle (F-150), 33.78 kPa (4.9 psi) at 90% VGTDC duty cycle (F-Series Super Duty) or 48.26 kPa (7.0 psi) at 100% VGTDC duty cycle (all others)?

Yes	The turbocharger system is operating correctly. RETURN to Section 3, Symptom Charts for further direction.
No	INSTALL a new Turbocharger assembly. REFER to the Workshop Manual Section 303-04, Fuel Charging and 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.

KA11 CHECK FOR INPUT SENSOR BIAS

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

Is the EBP within 7.5 kPa (1.09 psi) and the MAP_A within 5 kPa (0.73 psi) of the BARO PID reading?

Yes	For DTCs P0236 and P259F, INSTALL a new Turbocharger assembly. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls. CARRY OUT the Reset And Clear The Specified Function Turbo System and 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, GO to KA12 .
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 KA19 .

KA12 CHECK THE TURBOCHARGER OPERATION BOOST

- Ignition ON, engine running.
- Access the PCM and control the EGRVPDES (PER) PID.
- Command the PID duty cycle to 0%.
- Access the PCM and control the EGRTP_CMD (PER) PID.
- Command the EGRTP_CMD PID to the minimum value.
- Access the PCM and monitor the EBP (PRESS) and MAP (PRESS) PIDs.
- Access the PCM and control the RPMDS (RPM) PID.
- Command the engine speed to 1,500 RPM.
- Access the PCM and control the VGTDC (PER) PID.
- Command the VGTDC duty cycle to 100%.
- Command the VGTDC duty cycle to 0%.

Does the EBP and MAP pressure increase and decrease as the VGTDC PID is increased and decreased?

Yes	GO to KA17 .
No	GO to KA13 .

KA13 TURBOCHARGER COMPRESSOR WHEEL CHECK

- Inspect the turbocharger compressor wheel and housing for the following:
 - ability to spin freely
 - noise while spinning
 - damage to vanes on the compressor wheel
 - out of balance condition
 - debris in housing

Is a concern present?

Yes	REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls, Symptom Chart.
No	GO to KA14 .

KA14 CHECK THE OPERATION OF THE TURBOCHARGER ACTUATOR

NOTICE: The turbocharger actuator valve is sensitive to contamination. All work areas must be clean before starting this procedure. Do not allow contamination to enter the valve ports, cam follower, or turbocharger housing. Handle the turbocharger actuator by the solenoid body only. Do not attempt to clean or wipe oil off the valve with a cloth or shop rag. Do not let the valve come in contact with materials that could contaminate the valve mechanism.

- Ignition OFF.
- Turbocharger Actuator connector disconnected.
- Remove the turbocharger actuator from the turbocharger assembly.
- Turbocharger Actuator connector connected.
- Ignition ON, engine OFF.
- Access the PCM and control the VGTDC (PER) PID.
- Apply light pressure to the cam follower (tip of the actuator), while commanding the VGTDC duty cycle and check for the internal valve movement.
- Command the VGTDC PID duty cycle to 100%.

Is a concern present?

Yes	INSTALL a new Turbocharger Actuator solenoid. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Turbo System and 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.
No	GO to KA15 .

KA15 CLEAN THE TURBOCHARGER ACTUATOR AND RETEST

NOTICE: This step will be carried out with the intake manifold loosely assembled in the vehicle. It is necessary that all debris and loose items be removed or secured before starting the vehicle to prevent engine or turbocharger damage.

NOTICE: The turbocharger actuator valve is sensitive to contamination. All work areas must be clean before starting this procedure. Do not allow contamination to enter the valve ports, cam follower, or turbocharger housing. Handle the turbocharger actuator by the solenoid body only. Do not attempt to clean or wipe oil off the valve with a cloth or shop rag. Do not let the valve come in contact with materials that could contaminate the valve mechanism.

NOTICE: Use only the Carburetor Tune-Up Cleaner PM-2 to spray the actuator valve. Brake cleaner or other solvents may damage the actuator valve.

Note: Do not spray the zinc coated larger diameter housing, or electrical connector.

Spray the valve with Carburetor Tune-Up Cleaner PM-2 while pressing the cam follower (tip of the actuator).

- Clean and install the turbocharger actuator.
- Turbocharger Actuator connector connected.
- Loosely assemble the intake manifold in the vehicle.
- MAP Sensor connector connected.
- Ignition ON, engine running.
- Access the PCM and monitor the EBP (PRESS) PID.
- Access the PCM and control the EGRVPDES (PER) PID.
- Command the PID duty cycle to 0%.
- 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 duty cycle to 100%.
- Command the VGTDC PID duty cycle to 0%.

Does the EBP pressure increase and decrease as the VGTDC PID is increased and decreased?

Yes	The concern may have been caused by a contaminated turbocharger actuator valve. CHANGE the oil and oil filter assembly. INSTALL the intake manifold and all associated parts that were removed to carry out this test step. CLEAR the PCM DTCs. ROAD TEST the vehicle and ACCELERATE the vehicle to achieve full boost. REPEAT the self-test. If symptom or DTC is still present, GO to KA17.
No	INSTALL a new Turbocharger Actuator solenoid. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. CARRY OUT the Reset And Clear The Specified Function Turbo System and 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). GO to KA16.

KA16 RETEST THE TURBOCHARGER ACTUATOR

NOTICE: This step will be carried out with the intake manifold loosely assembled in the vehicle. It is necessary that all debris and loose items be removed or secured before starting the vehicle to prevent engine or turbocharger damage.

NOTICE: The turbocharger actuator valve is sensitive to contamination. All work areas must be clean before starting this procedure. Do not allow contamination to enter the valve ports, cam follower, or turbocharger housing. Handle the turbocharger actuator by the solenoid body only. Do not attempt to clean or wipe oil off the valve with a cloth or shop rag. Do not let the valve come in contact with materials that could contaminate the valve mechanism.

- Turbocharger Actuator connector connected.
- Loosely assemble the intake manifold in the vehicle.
- MAP Sensor connector connected.
- Ignition ON, engine running.
- Access the PCM and monitor the EBP (PRESS) PID.
- Access the PCM and control the EGRVPDES (PER) PID.
- Command the PID duty cycle to 0%.
- 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 duty cycle to 100%.

- Command the VGTDC PID duty cycle to 0%.

Does the EBP pressure increase and decrease as the VGTDC PID is increased and decreased?

Yes	INSTALL the intake manifold and all associated parts that were removed to carry out this test step. GO to KA17 .
No	INSTALL a new Turbocharger assembly. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls. CARRY OUT the Reset And Clear The Specified Function Turbo System and 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.

KA17 CHECK THE TURBOCHARGER BOOST PRESSURE

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

Note: MAP_A PID reading is an absolute value, not a gauge value.

- Access the PCM and monitor the EOT (TEMP) PID.
- Allow the engine to idle with the engine oil temperature (EOT) greater than 70C (158F).
- Access the PCM and monitor the BARO (PRESS) and MAP (PRESS) PIDs.
- Access the PCM and control the EGRVPDES (PER) PID.
- Command the PID to 0%.
- Access the PCM and control the EGRTP_CMD (PER) PID.
- Command the EGRTP_CMD PID to the minimum value.
- 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 duty cycle to 100%.
- Record the MAP_A PID value.
- Command the VGTDC PID duty cycle to 0%.
- Record the MAP_A PID value.

Is the MAP PID reading within 5% of the BARO PID reading at 0% VGTDC duty cycle and does the MAP PID increase by greater than 36 kPa (5.20 psi) (pickup vehicles) or 48 kPa (6.96 psi) (all others) at 100% VGTDC duty cycle?

Yes	The turbocharger system is operating correctly. RETURN to Section 3, Symptom Charts for further direction.
No	GO to KA18 .

KA18 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 control the EGRVPDES (PER) PID.
- Command the EGRVPDES PID to the minimum value.
- Access the PCM and monitor the MAF_HZ (FREQ) PID.
- Record the highest MAF_HZ PID value after 30 seconds.
- 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 highest MAF_HZ PID value after 30 seconds.
- Subtract the unblocked MAF_HZ PID value from the blocked 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 difference between the unblocked MAF_HZ PID value and the blocked MAF_HZ PID value less than 0.2 kHz?

Yes	INSTALL a new Turbocharger assembly. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls. CARRY OUT the Reset And Clear The Specified Function Turbo System and 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.
No	DIAGNOSE the EGR system. GO to Pinpoint Test W.

KA19 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.

mcx30.com