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2020 Ford F-350 Super Duty Service and Repair Manual

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PCM (powertrain control module) SHRTFT1 (Short term fuel trim 1) (%)	%	PID	0.00 (A)	-10 TO +10	-10 TO +10	-10 TO +10
PCM (powertrain control module) SHRTFT2 (Short term fuel trim 2) (%)	%	PID	0.00 (A)	-10 TO +10	-10 TO +10	-10 TO +10
PCM (powertrain control module) SPARKADV (Spark Advance) (Deg)	DEG	PID	7.00	-3.50	17.50	30.00
PCM (powertrain control module) SYNC ((CMP) and (CKP) Synchronized)	YES/NO	PID	No (False)	No (False)	YES (True)	YES (True)
PCM (powertrain control module) TCBP (Measured Boost at Throttle Inlet Pressure Sensor) (kPa)	kPa (PSI)	TCBP Sensor	98.4 (14.27)	98.4 (14.27)	99.5 (14.43)	101.6 (14.74)
PCM (powertrain control module) TCBP_V (Throttle Inlet Pressure Sensor Voltage) (V)	VOLTS	TCBP Sensor	1.41	1.41	1.43	1.45
PCM (powertrain control module) TP1_LRN_TRIM (Throttle Position Sensor 1 Learned Offset) (Deg)	DEG	ETBTPS	10.13	10.13	10.13	10.13
PCM (powertrain control module) TP1_PER (Throttle Position Sensor 1) (%)	%	ETBTPS	17	17	16	17
PCM (powertrain control module) TP2_LRN_TRIM (Throttle Position Sensor 2 Learned Offset) (Deg)	DEG	ETBTPS	0.00	0.00	0.00	0.00
PCM (powertrain control module) TP_REL (Relative Throttle Position) (%)	VOLTS	PID	7.1	7.1	5.5	7.5

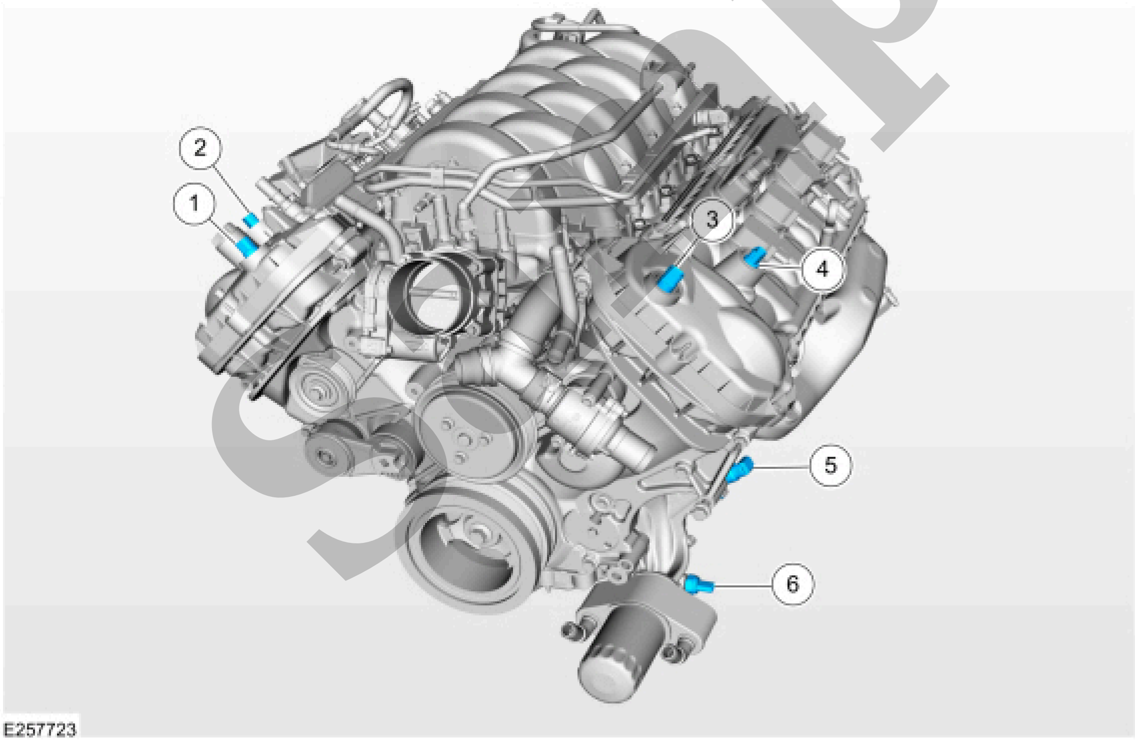
PCM (powertrain control module) VCT_EXH_DIF2 (Exhaust B Camshaft Desired Minus Actual Bank 2) (Deg)	DEG	PID	0.00	-0.06	-2.13	5.25
PCM (powertrain control module) VCT_INT_ACT1 (Actual Intake A Camshaft Position Bank 1) (Deg)	DEG	PID	0.00	0.19	0.00	-0.13
PCM (powertrain control module) VCT_INT_ACT2 (Actual Intake A Camshaft Position Bank 2) (Deg)	DEG	PID	0.00	0.13	-0.06	0.06
PCM (powertrain control module) VCT_INT_DC1 (Intake A Camshaft Position Duty Cycle Bank 1) (%)	%	VCT11 Solenoid	0	0	0	0
PCM (powertrain control module) VCT_INT_DC2 (Intake A Camshaft Position Duty Cycle Bank 2) (%)	%	VCT21 Solenoid	0	0	0	0
PCM (powertrain control module) VCT_INT_DIF1 (Intake A Camshaft Desired Minus Actual Bank 1) (Deg)	DEG	PID	0.00	-0.31	0.06	0.13
PCM (powertrain control module) VCT_INT_DIF2 (Intake A Camshaft Desired Minus Actual Bank 2) (Deg)	DEG	PID	0.00	-0.13	0.00	-0.06
PCM (powertrain control module) VPWR (Module Supply Voltage) (V)	VOLTS	PID	13.19	14.40	14.35	14.32
PCM (powertrain control module) VREF (Reference Voltage) (V)	VOLTS	PID	5.01	5.01	5.01	5.01

Electronic Engine Controls - Component Location

303-14D Electronic Engine Controls - 5.0L 32V Ti-VCT	***2022 F-150***
Description and Operation	***Procedure revision date: 10/14/2020***

Electronic Engine Controls - Component Location

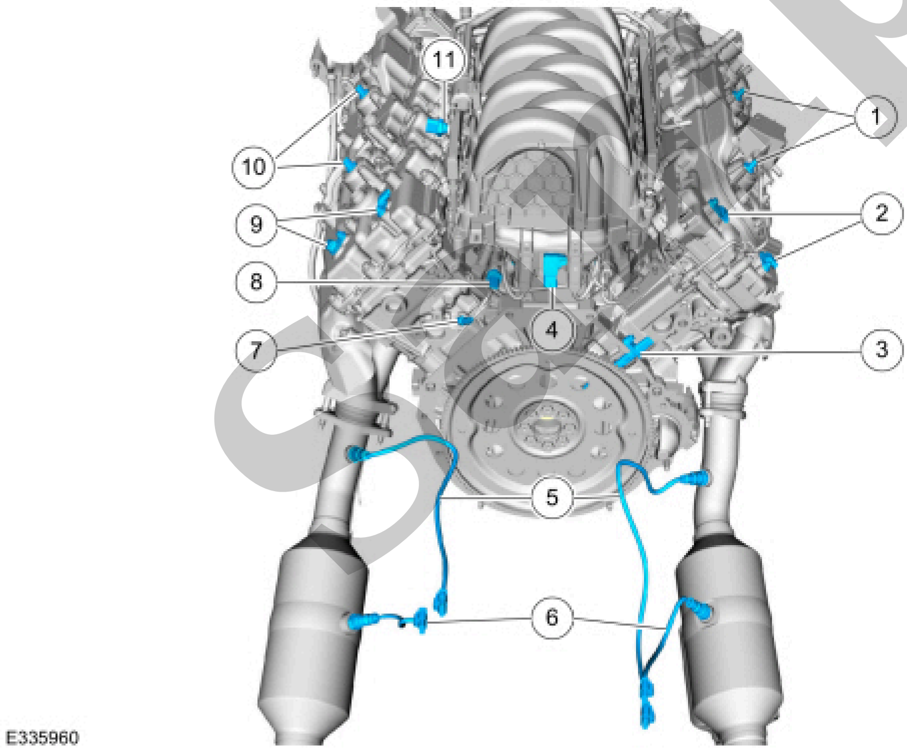
Electronic Engine Controls- Front



Item	Description
1	RH Intake VCT (variable camshaft timing) Oil Control Solenoid
2	RH Exhaust VCT (variable camshaft timing) Oil Control Solenoid

7	LH Catalyst Monitor sensor
8	RH Catalyst Monitor sensor
9	RH HO2S (heated oxygen sensor)
10	CKP (crankshaft position) sensor
11	CHT (cylinder head temperature) sensor
12	RH CMP (camshaft position) sensors
13	RH IMRC (intake manifold runner control) Actuator
14	IMRC (intake manifold runner control) Solenoid

Electronic Engine Controls - Rear Dual Alternator



Item	Description
1	RH (right-hand) Cylinder Deactivation Solenoids
2	RH (right-hand) CMP (camshaft position) sensors

2	KS (knock sensor)

Engine Oil Level Sensor

Item	Description
1	Engine oil level sensor

Powertrain Control Module (PCM)

Electronic Engine Controls - Overview

303-14D Electronic Engine Controls - 5.0L 32V Ti-VCT	***2022 F-150***
Description and Operation	***Procedure revision date: 10/13/2014***

Electronic Engine Controls - Overview

Overview

The EEC system provides optimum control of the engine through the enhanced capability of the powertrain control module (PCM). The EEC system also has an on board diagnostic (OBD) monitoring system with features and functions to meet federal regulations on exhaust emissions. The EEC system has two major divisions: hardware and software. The hardware includes the PCM, sensors, switches, actuators, solenoids, and interconnecting terminals. The software in the PCM provides the strategy control for outputs (engine hardware) based on the values of the inputs to the PCM. The PCM receives information from a variety of sensor and switch inputs. Based on the strategy and calibration stored within the PCM, the PCM generates the appropriate output. The system is designed to minimize emissions and optimize fuel economy and driveability. The software strategy controls the basic operation of the engine, provides the OBD strategy, controls the malfunction indicator lamp (MIL), communicates to the scan tool over the data link connector (DLC), allows for flash electrically erasable programmable read only memory (EEPROM), provides idle air and fuel trim, and controls failure mode effects management (FMEM).

- The maximum engine off time is exceeded
- The engine operating temperature is less than 60°C (140°F)
- The gear selector is in the PARK, REVERSE, NEUTRAL or SECOND GEAR position
- Initial vehicle speed of greater than 4 km/h (2.5 MPH) and less than 2 seconds has elapsed
- The vehicle is on a steep road grade
- Elevation is above 12,000 feet (3,657 meters) approximately
- The CPP (clutch pedal position) sensor indicates the clutch pedal is not fully released

Any of the following conditions may result in an automatic restart of the engine:

- The blower fan speed is increased or the climate control temperature is changed
- An electrical accessory is turned ON or plugged in
- Incorrect brake vacuum
- The auto start stop switch is pressed to disable the system while the engine is stopped

Automatic Engine Idle Shutdown

Vehicles equipped with automatic engine idle shutdown have an instrument panel cluster message and an audible alert that notifies the driver 30 seconds prior to engine shutdown. When the shutdown occurs, the PCM (powertrain control module) broadcasts a shutdown message and vehicle power is disabled. For additional information on the automatic engine idle shutdown, refer to the Owners Literature.

Shutdown occurs under the following conditions:

- The vehicle is stationary
- The gear selector is in the PARK or NEUTRAL position or the clutch pedal is released
- The accelerator pedal is released
- The brake pedal is released
- Scan tool is not connected

Comprehensive Component Monitor (CCM)

The CCM checks for concerns in any powertrain electronic component or circuit that provides input or output signals to the PCM (powertrain control module) that can affect emissions and is not monitored by another OBD (on-board diagnostic) monitor. Inputs and outputs are, at a minimum, monitored for circuit continuity or the OFF, ACC or LOCK position, the PCM (powertrain control module) stays powered up until the correct engine shutdown occurs.

The ISP-R and the INJPWRM circuits provide the ignition state input to the PCM (powertrain control module) . Based on the ISP-R and INJPWRM signals the PCM determines when to power down the PCM (powertrain control module) power relay.

Engine Off Timer Monitor

The engine off time is obtained from the PCM (powertrain control module) or the BCM (body control module) . If the engine off time is obtained from the BCM (body control module) , the PCM (powertrain control module) expects to receive a message with the engine off time from the BCM (body control module) shortly after engine start up. If the message is not available on the controller area network (CAN) or a battery disconnect has occurred, a communication DTC (diagnostic trouble code) sets.

There are two parts to this test.

The first part determines if the timer is incrementing during engine OFF. The PCM (powertrain control module) determines the timer is incrementing during engine OFF by comparing the engine coolant temperature value prior to shut down, to the engine coolant temperature value at ignition ON to determine if an engine OFF soak has occurred. For an engine OFF soak to occur, the engine coolant temperature value must be greater than 71°C (160 °F) while the engine is running. The timer starts at ignition OFF and the engine coolant temperature value must decrease by greater than 17°C (30 °F) before the next ignition ON signal. If the engine off timer indicates a value less than 30 seconds, a DTC (diagnostic trouble code) sets.

The second part checks the accuracy of the engine off timer. The PCM (powertrain control module) determines the accuracy of the engine off timer by comparing time in the BCM (body control module) with the time in the PCM (powertrain control module) . The timer in the BCM (body control module) is allowed to count up for 5 minutes and compared to a different clock in the PCM (powertrain control module) . If the two timers differ by more than 15 seconds, a DTC (diagnostic trouble code) sets.

Engine RPM Limiter

The PCM (powertrain control module) disables some or all of the fuel injectors whenever an engine RPM (revolutions per minute) over speed condition is detected. The purpose of the engine RPM (revolutions per minute) limiter is to prevent damage to the powertrain. Once the driver reduces the excessive engine speed, the engine returns to the normal operating mode. No repair is required. However, the technician should clear the DTCs and inform the customer of the reason for the DTC (diagnostic trouble code) .

Excessive wheel slippage may be caused by sand, gravel, rain, mud, snow, ice, or excessive and sudden increase in RPM (revolutions per minute) while in NEUTRAL or while driving.

Failure Mode Effects Management (FMEM)

The FMEM is an alternate system strategy in the PCM (powertrain control module) designed to maintain engine operation if one or more sensor inputs fail.

Engine Load	Road Conditions (Smooth-Bumpy)
Engine Idle/Accel/Deceleration	

Accumulating PCM Data

The PCM (powertrain control module) data can be accumulated in a number of ways. This includes circuit measurements with a DMM (digital multimeter) or scan tool PID (parameter identification) data. Acquisition of PCM (powertrain control module) PID (parameter identification) data using a scan tool is one of the easiest ways to gather information. Gather as much data as possible when the concern is occurring to prevent improper diagnosis. Data should be accumulated during different operating conditions and based on the customer description of the intermittent concern. Compare this data with the known good data values.

Peripheral Inputs

Some signals may require certain peripherals or auxiliary tools for diagnosis. In some cases, these devices can be inserted into the measurement jacks of the scan tool or DMM (digital multimeter) . For example, connecting an electronic fuel pressure gauge to monitor and record the fuel pressure voltage reading and capturing the data would help find the fault.

Comparing PCM Data

After the PCM (powertrain control module) values are acquired, it is necessary to determine the concern area. This typically requires the comparison of the actual values from the vehicle to known good data values.

Analyzing PCM Data

Look for abnormal events or values that are clearly incorrect. Inspect the signals for abrupt or unexpected changes. For example, during a steady cruise most of the sensor values should be relatively stable. Sensors such as TP (throttle position) , as well as an RPM (revolutions per minute) that changes abruptly when the vehicle is traveling at a constant speed, are clues to a possible concern area.

Look for an agreement in related signals. For example, if the APP1 or APP2 changes during acceleration, a corresponding change should occur in RPM and SPARK ADV PID (parameter identification) .

Make sure the signals act in proper sequence. An increase in RPM (revolutions per minute) after the TP1 and TP2 increases is expected. If the RPM (revolutions per minute) increases without a TP1 and TP2 change, a concern may exist.

The PID (parameter identification) values are not always captured from the same execution loop. Depending on the number of PIDs acquired, the sample rate may be 60 ms or longer. For example, the ETC_ACT reading will always lag behind the ETC_DSD reading due to the physical time to move the throttle plate. This is an expected difference between ETC_ACT and ETC_DSD during these events.

Scroll through the PID data while analyzing the information. Look for sudden drops or spikes in the values.