

P0020 - A Camshaft Position Actuator A Control Circuit/Open Bank 2

| | | | | |
|-------------------------|--|--|------------------------------|--------------------------|
| Description: | This DTC sets when a low or high voltage on the VCT21 circuit is detected. This DTC sets if the voltage exceeds a calibrated limit for a calibrated amount of time. | | | |
| Possible Causes: | <ul style="list-style-type: none">• VCT21 circuit open• VCT21 circuit short to voltage• VCT21 circuit short to ground• VPWR circuit open• Damaged variable camshaft timing bank 2 solenoid 1 (VCT21) | | | |
| Diagnostic Aids: | | | | |
| Application | | Key On Engine Off | Key On Engine Running | Continuous Memory |
| All | | GO to Pinpoint Test HK . | | |

Section 5: Pinpoint Tests

2018 Gasoline

Procedure revision date: 08/27/2019

C: Reference Voltage (VREF)

This pinpoint test is intended to diagnose the following:

- harness circuits: APPVREF1, APPVREF2, APPRTN1, APPRTN2, ETCREF, ETCRTN, SIGRTN and VREF
- accelerator pedal position (APP) sensor (9F836)
- air conditioning pressure (ACP) sensor (19D594)
- brake vacuum sensor
- crankcase pressure sensor (6758)
- crankshaft position (CKP) sensor (6C315)
- camshaft position (CMP) sensor (6B288)
- differential pressure feedback exhaust gas recirculation (EGR) sensor
- electric exhaust gas recirculation (EGR) valve
- electronic throttle body throttle position sensor (ETBTPS) (9E928)
- exhaust pressure (EP) sensor
- fuel pressure sensor (9F972)
- fuel rail pressure (FRP) sensor (6B288)
- fuel rail pressure temperature (FRPT) sensor (9G756)
- fuel tank pressure (FTP) sensor (9C052)
- generator current sensor (14B357)
- intake manifold runner control bank 1 (IMRC1) sensor (9J559)
- intake manifold runner control bank 2 (IMRC2) sensor (9J559)
- manifold absolute pressure (MAP) sensor (9F479)
- manifold absolute pressure temperature (MAPT) sensor (9F479)
- manifold absolute pressure (MAP)/charge air cooler temperature (CACT) sensor (9F479)

- manifold absolute pressure (MAP)/intake air temperature 2 (IAT2) sensor (9F479)
- particulate filter pressure bank 1, sensor 1 (9G824)
- turbocharger boost pressure (TCBP) sensor (9F479)
- turbocharger boost pressure (TCBP)/charge air cooler temperature (CACT) sensor (9F479)
- turbocharger inlet pressure and temperature (TCIPT) sensor (9F479)
- wastegate vacuum sensor (9F479)
- PCM (12A650)

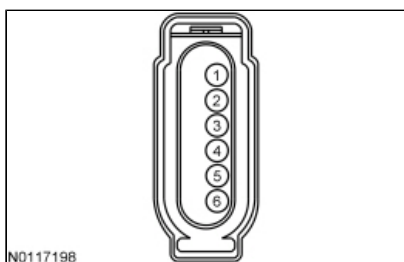
SENSORS CONNECTED TO REFERENCE VOLTAGE

| Applications | APP Or FTP Or ACP | Fuel Pressure Sensor Or FRP Or FRPT | MAP Or MAPT Or TCBP Or TCBP/ CACT Or MAP/CACT Or MAP/ IAT2 Or TCIPT | CKP Or CMP | WVS | CPP | Generator Current Sensor | IMRC | Crankcase Pressure Sensor | Brake Vacuum Sensor Or DPFEGR Sensor Or EP Sensor Or Particulate Filter Pressure Sensor |
|---|--|--|--|---------------------------|------------|------------|---|-------------|--|--|
| Continental, Edge, Escape/Kuga, Explorer, Fusion, MKC, MKX, MKZ | X | X | X | X | X | | X | | X | X |
| EcoSport, Fiesta, Focus, KA | X | X | X | X | | X | X | | X | X |
| E-Series, F- Series Super Duty | X | | | | | | X | X | | |
| Expedition, F-150, Mustang, Navigator | X | X | X | X | X | | X | X | X | X |
| F-650 / F- 750, Motorhome / Stripped Chassis / | X | | | | | | X | | | |

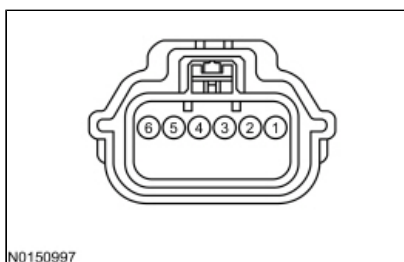
| Applications | APP Or FTP Or ACP | Fuel Pressure Sensor Or FRP Or FRPT | MAP Or MAPT Or TCBP Or TCBP/ CACT Or MAP/CACT Or MAP/ IAT2 Or TCIPT | CKP Or CMP | WVS | CPP | Generator Current Sensor | IMRC | Crankcase Pressure Sensor | Brake Vacuum Sensor Or DPFEGR Sensor Or EP Sensor Or Particulate Filter Pressure Sensor |
|----------------------------------|--|--|--|---------------------------|------------|------------|---|-------------|--|--|
| Step Van | | | | | | | | | | |
| Flex, MKT, Taurus, Transit | X | X | X | X | | | X | | X | X |
| Ford GT | X | X | X | X | | | X | | X | X |
| Ranger | X | | X | X | | | X | | X | |
| Transit Connect | X | | X | X | | | X | | X | X |

Accelerator Pedal Position (APP) Sensor Connector

A



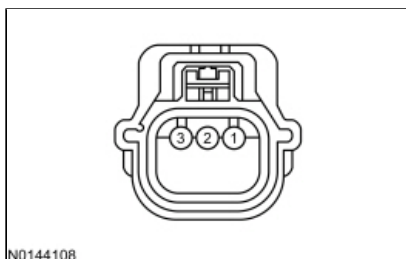
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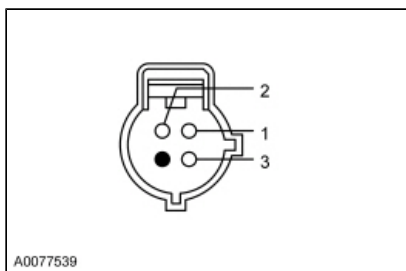
| Vehicle | Connector | Pin | Circuit |
|--------------------|-----------|-----|----------|
| Fiesta | A | 3 | APPRTN2 |
| | | 1 | APPVREF2 |
| All other vehicles | B | 4 | APPRTN2 |
| | | 6 | APPVREF2 |
| | | 3 | APPRTN1 |
| | | 1 | APPVREF1 |

Air Conditioning Pressure (ACP) Transducer Sensor Connector

A



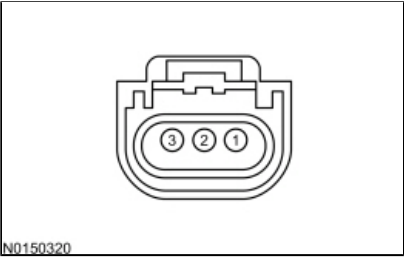
B



| Vehicle | Connector | Pin | Circuit |
|--------------------------|-----------|-----|---------|
| Expedition, Navigator | A | 1 | SIGRTN |
| | | 2 | VREF |
| Fiesta, Ranger | B | 1 | SIGRTN |
| | | 2 | VREF |

| Vehicle | Connector | Pin | Circuit |
|--------------------|-----------|-----|---------|
| All other vehicles | A | 1 | SIGRTN |
| | | 3 | VREF |

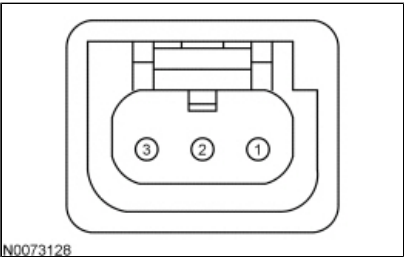
Brake Vacuum Sensor Connector



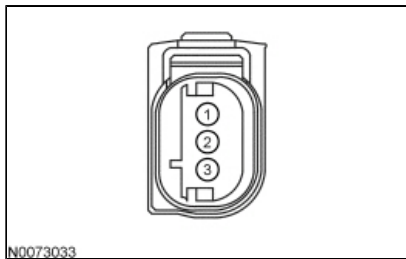
| Pin | Circuit |
|-----|--------------------------|
| 2 | SIGRTN (Signal Return) |
| 3 | VREF (Reference Voltage) |

Camshaft Position Bank 1 Sensor 1 (CMP11) Sensor Connector

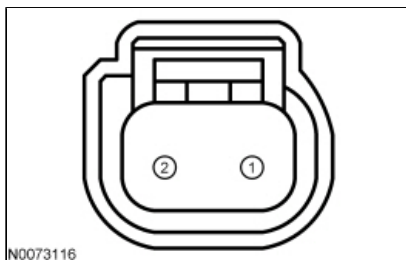
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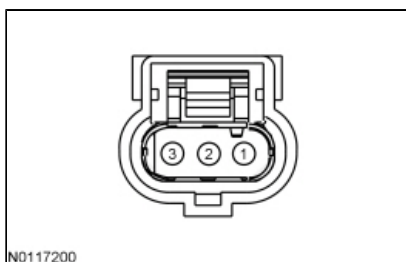
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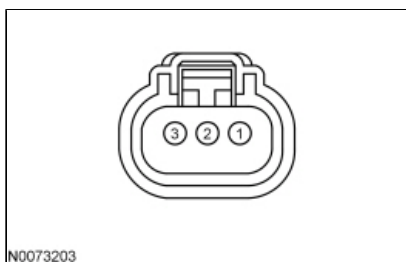
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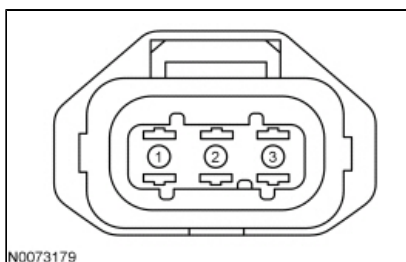
D



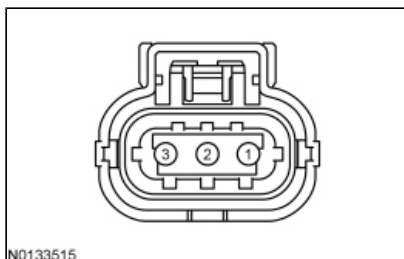
E



F



G



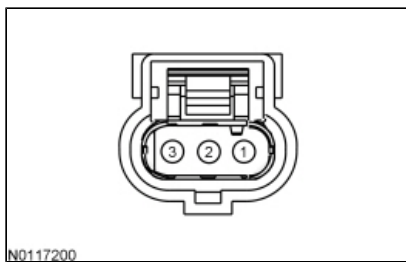
N0133515

| Vehicle | Connector | Pin | Circuit |
|---|-----------|--------|----------------|
| Continental 2.0L, EcoSport 2.0L, Edge 2.0L, Escape/Kuga 2.0L, Explorer 2.3L, Focus 2.0L, Focus 2.3L, Fusion 2.0L, MKC, MKT 2.0L, MKX 2.0L, MKZ 2.0L, Mustang 2.3L, Taurus 2.0L | A | 2 1 | SIGRTN VREF |
| E-Series 6.2L, F-Series Super Duty 6.2L | B | 2 | SIGRTN |
| E-Series 6.8L, F-650 / F-750, F-Series Super Duty 6.8L, Flex TiVCT 3.5L, | C | 1 | SIGRTN |

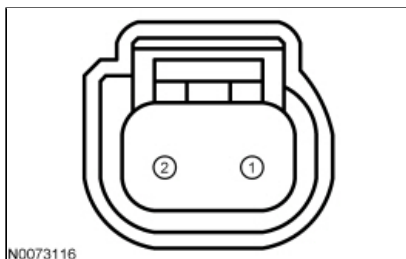
| Vehicle | Connector | Pin | Circuit |
|---|-----------|--------|----------------|
| MKT 3.7L, Motorhome / Stripped Chassis / Step Van, Taurus 3.7L | | | |
| EcoSport 1.5L, F-150 5.0L, Mustang 5.0L | D | 2 1 | SIGRTN VREF |
| EcoSport 1.0L, Fiesta TiVCT 1.6L, Focus 1.0L, Ranger | D | 3 1 | SIGRTN VREF |
| Escape/Kuga 2.5L, Fusion 2.5L, Transit Connect | E | 3 | SIGRTN |
| Escape/Kuga 1.5L, Fiesta GTDI 1.6L, Fusion 1.5L | F | 1 3 | SIGRTN VREF |
| Expedition, F-150 3.3L, F-150 3.5L, F-150 2.7L, Navigator | D | 2 3 | SIGRTN VREF |
| Fiesta 1.0L, KA | G | 3 1 | SIGRTN VREF |
| Mustang 5.2L | B | 3 | SIGRTN |
| All other vehicles | D | 2 | SIGRTN |

Camshaft Position Bank 1 Sensor 2 (CMP12) Sensor Connector

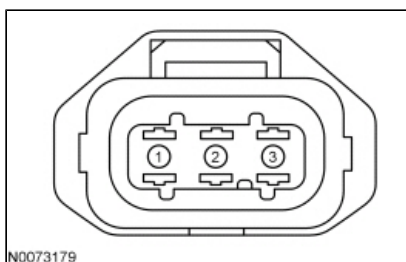
A



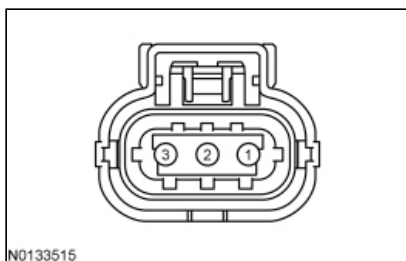
B



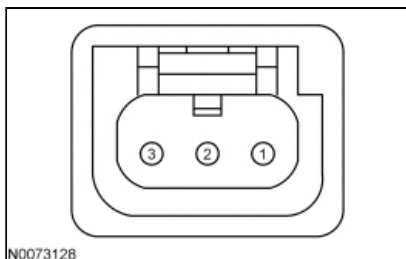
C



D



E



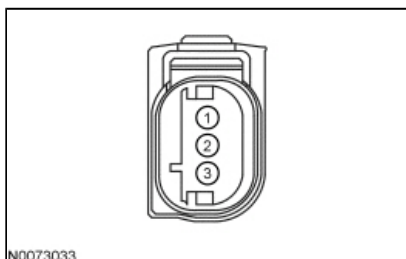
N0073128

| Vehicle | Connector | Pin | Circuit |
|---|-----------|--------|----------------|
| Continental 2.7L, Continental 3.0L, Edge 2.7L, Ford GT, Fusion 2.7L, MKX 2.7L, MKZ 3.0L, Transit 3.5L | A | 2 | SIGRTN |
| Continental 3.7L, Edge 3.5L, Explorer 3.7L, Explorer 3.5L, Flex, MKT 3.7L, MKX 3.7L, Mustang 5.2L, Taurus 3.5L, Taurus 3.7L, Transit 3.7L | B | 1 | SIGRTN |
| EcoSport 1.5L, F-150 5.0L, Mustang 5.0L | A | 1 2 | VREF SIGRTN |
| EcoSport 1.0L, | A | 1 | VREF |

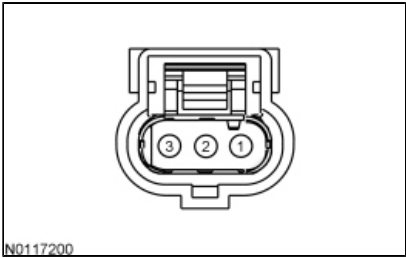
| Vehicle | Connector | Pin | Circuit |
|---|-----------|--------|----------------|
| Fiesta TiVCT 1.6L, Focus 1.0L | | 3 | SIGRTN |
| Escape/Kuga 1.5L, Fiesta GTDI 1.6L, Fusion 1.5L | C | 3 1 | VREF SIGRTN |
| Expedition, F-150 2.7L, F-150 3.3L, F-150 3.5L, Navigator | A | 3 2 | VREF SIGRTN |
| Fiesta 1.0L, KA | D | 1 3 | VREF SIGRTN |
| All other vehicles | E | 1 2 | VREF SIGRTN |

Camshaft Position Bank 2 Sensor 1 (CMP21) Sensor Connector

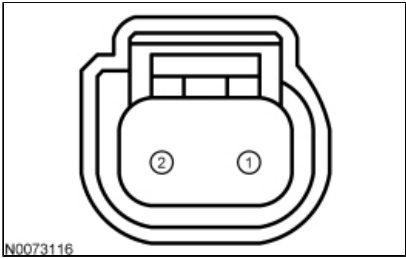
A



B



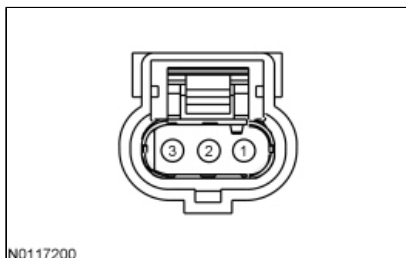
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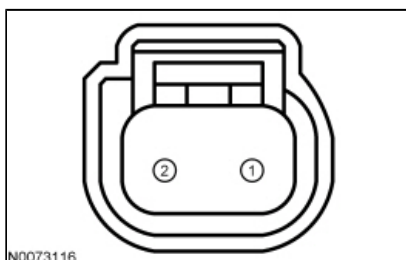
| Vehicle | Connector | Pin | Circuit |
|---|-----------|--------|----------------|
| E-Series, F-Series Super Duty | A | 2 | SIGRTN |
| Expedition, F-150 2.7L, F-150 3.3L, F-150 3.5L, Navigator | B | 2 3 | SIGRTN VREF |
| F-150 5.0L | B | 2 1 | SIGRTN VREF |
| Flex TiVCT 3.5L, MKT 3.7L | C | 1 | SIGRTN |
| Mustang 5.0L | A | 2 1 | SIGRTN VREF |
| Mustang 5.2L | A | 3 | SIGRTN |
| All other vehicles | B | 2 | SIGRTN |

Camshaft Position Bank 2 Sensor 2 (CMP22) Sensor Connector

A



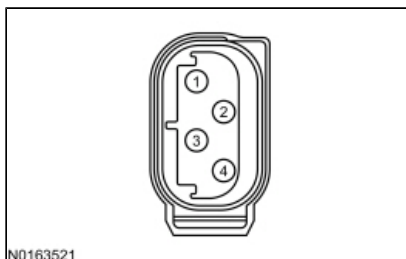
B



| Vehicle | Connector | Pin | Circuit |
|--|-----------|--------|----------------|
| Continental 2.7L, Continental 3.0L, Edge 2.7L, Ford GT, Fusion, MKX 2.7L, MKZ, Transit 3.5L | A | 2 | SIGRTN |
| Expedition, F-150 2.7L, F-150 3.3L, F-150 3.5L, Navigator | A | 2 3 | SIGRTN VREF |
| F-150 5.0L, | A | 2 | SIGRTN |

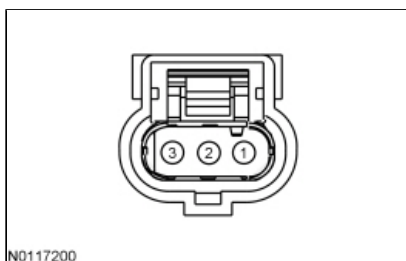
| Vehicle | Connector | Pin | Circuit |
|--------------------|-----------|-----|---------|
| Mustang 5.0L | | 1 | VREF |
| All other vehicles | B | 1 | SIGRTN |

Clutch Pedal Position (CPP) Sensor Connector



| Pin | Circuit |
|-----|--------------------------|
| 1 | SIGRTN (Signal Return) |
| 3 | VREF (Reference Voltage) |

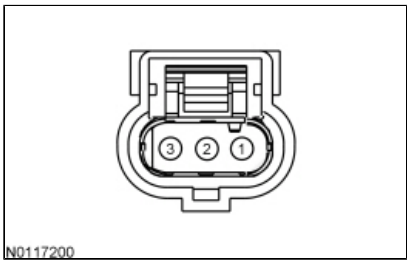
Crankcase Pressure Sensor Connector



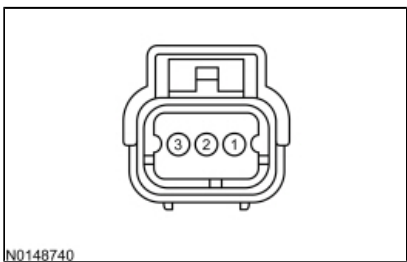
| Pin | Circuit |
|-----|--------------------------|
| 2 | SIGRTN (Signal Return) |
| 3 | VREF (Reference Voltage) |

Crankshaft Position (CKP) Sensor Connector

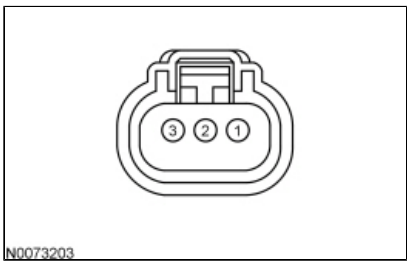
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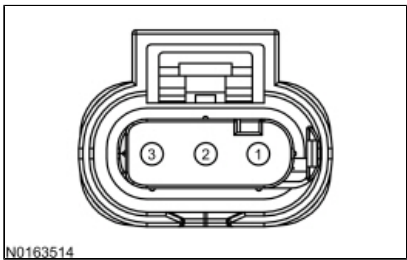
B



C



D

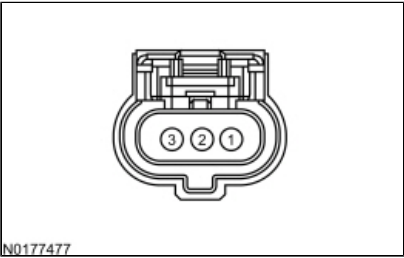


| Vehicle | Connector | Pin | Circuit |
|--|-----------|--------|----------------|
| Continental 2.7L, Continental 3.0L, | A | 1 3 | SIGRTN VREF |

| Vehicle | Connector | Pin | Circuit |
|--|-----------|--------|----------------|
| Edge 2.7L, F-150 2.7L, F-150 5.0L, MKX 2.7L, MKZ 3.0L, Mustang 5.0L | | | |
| EcoSport 1.0L, Escape/Kuga 1.5L, Fiesta, Focus 1.0L, KA | B | 2 1 | SIGRTN VREF |
| EcoSport 1.5L | A | 2 1 | SIGRTN VREF |
| Expedition, Explorer GTDI 3.5L, F-150 3.3L, F-150 3.5L, Flex, Ford GT, MKT 3.5L, Navigator, Taurus GTDI 3.5L, Transit | A | 2 3 | SIGRTN VREF |
| Explorer 2.3L, Focus GDI 2.0L, MKC 2.3L, MKT 2.0L, Mustang 2.3L, | C | 3 1 | SIGRTN VREF |

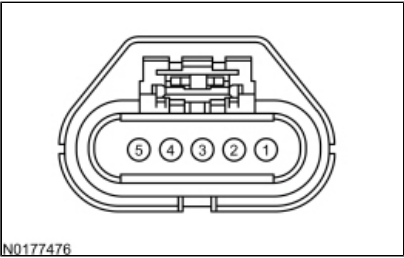
| Vehicle | Connector | Pin | Circuit |
|--------------------|-----------|-----|---------|
| Taurus 2.0L | | | |
| Fusion 1.5L | D | 2 | SIGRTN |
| | | 1 | VREF |
| Fusion 2.7L | A | 1 | SIGRTN |
| | | 2 | VREF |
| All other vehicles | A | 3 | SIGRTN |
| | | 1 | VREF |

Differential Pressure Feedback EGR Sensor Connector



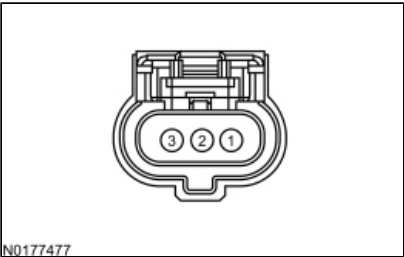
| Pin | Circuit |
|-----|--------------------------|
| 3 | VREF (Reference Voltage) |
| 2 | SIGRTN (Signal Return) |

Electric Exhaust Gas Recirculation (EEGR) Assembly Connector



| Vehicle | Connector | Pin | Circuit |
|------------|-----------|-----|---------|
| F-150 2.7L | A | 3 | VREF |
| | | 1 | SIGRTN |
| F-150 3.3L | A | 3 | VREF |
| | | 5 | SIGRTN |

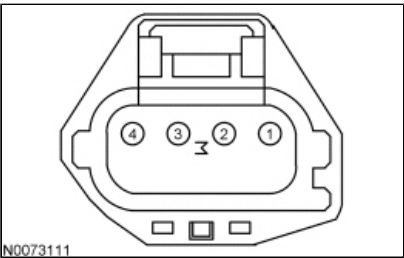
Exhaust Pressure (EP) Sensor Connector



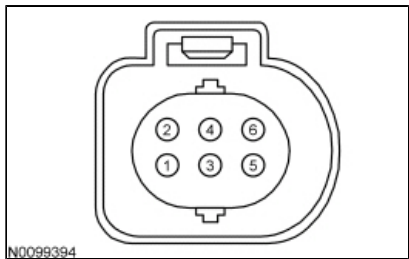
| Pin | Circuit |
|-----|--------------------------|
| 2 | SIGRTN (Signal Return) |
| 1 | VREF (Reference Voltage) |

Electronic Throttle Body Throttle Position Sensor (ETBTPS) Connector

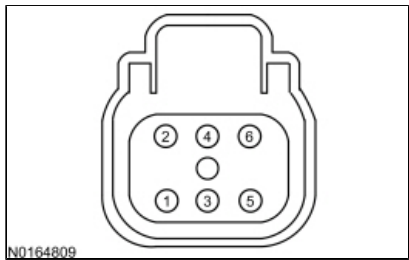
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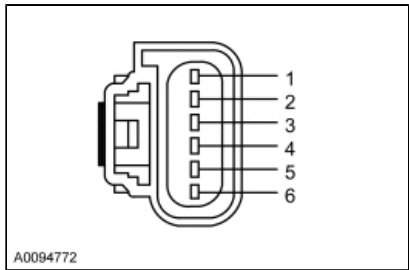
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C



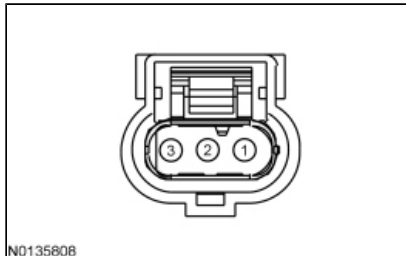
D



| Vehicle | Connector | Pin | Circuit |
|--|-----------|--------|------------------|
| E-Series 6.8L, Explorer GTDI 3.5L, F-650 / F-750, F-Series Super Duty 6.8L, Flex GTDI 3.5L, MKT 3.5L, Motorhome / Stripped Chassis / Step Van, Taurus GTDI 3.5L | A | 3 2 | ETCRTN ETCREF |
| EcoSport 1.5L, EcoSport 1.0L, Escape/Kuga 1.5L, | B | 3 1 | ETCRTN ETCREF |

| Vehicle | Connector | Pin | Circuit |
|--|-----------|--------|------------------|
| Fiesta 1.0L, Focus 1.0L, Fusion 1.5L, KA 1.0L | | | |
| Fiesta 1.6L | C | 2 6 | ETCRTN ETCREF |
| KA 1.5L | B | 2 6 | ETCRTN ETCREF |
| All other vehicles | D | 4 5 | ETCRTN ETCREF |

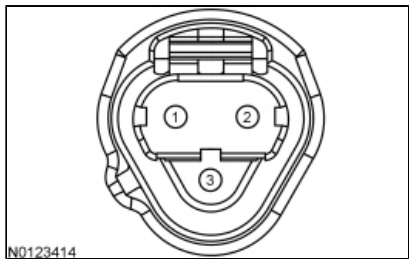
Fuel Pressure Sensor Connector



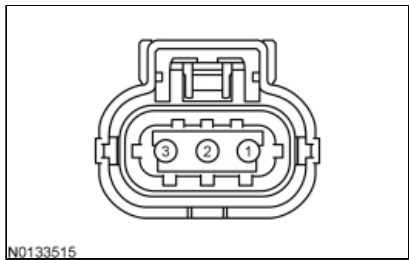
| Pin | Circuit |
|-----|--------------------------|
| 2 | SIGRTN (Signal Return) |
| 3 | VREF (Reference Voltage) |

Fuel Rail Pressure (FRP) Sensor Connector

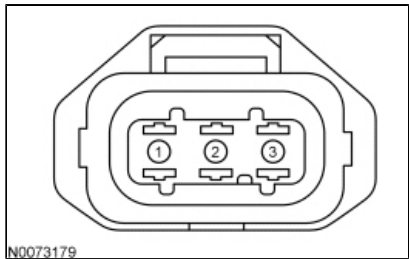
A



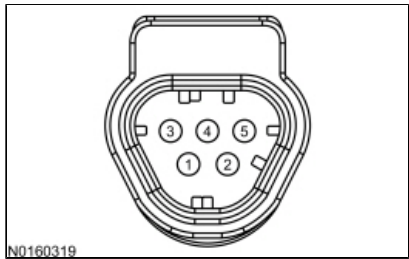
B



C



D

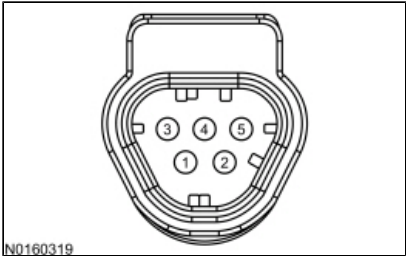


| Vehicle | Connector | Pin | Circuit |
|-------------------|-----------|-----|---------|
| Continental 2.7L, | A | 3 | SIGRTN |
| Continental 3.0L, | | 1 | VREF |
| EcoSport 2.0L, | | | |
| Edge 2.7L, | | | |
| Focus GDI 2.0L, | | | |

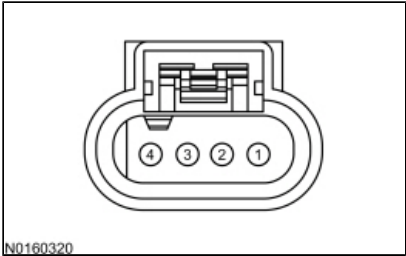
| Vehicle | Connector | Pin | Circuit |
|--|-----------|--------|----------------|
| Fusion 2.7L, MKX 2.7L, MKZ 3.0L, Transit | | | |
| EcoSport 1.0L | B | 3 1 | SIGRTN VREF |
| Escape/Kuga 1.5L, Fusion 1.5L | C | 2 1 | SIGRTN VREF |
| Escape/Kuga 2.0L | D | 5 3 | SIGRTN VREF |
| Expedition, Navigator | D | 3 4 | SIGRTN VREF |
| Explorer GTDI 3.5L, Fiesta, Flex, Focus GTDI 2.0L, Focus 1.0L, Fusion 2.0L, MKC 2.0L, MKT, MKZ 2.0L, Taurus | C | 1 3 | SIGRTN VREF |
| F-150 2.7L, F-150 5.0L, Mustang 5.0L | B | 2 1 | SIGRTN VREF |
| All other vehicles | D | 3 5 | SIGRTN VREF |

Fuel Rail Pressure Temperature (FRPT) Sensor Connector

A



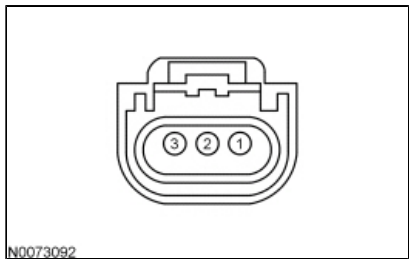
B



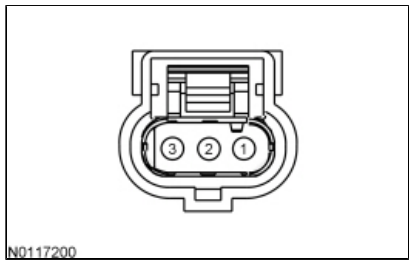
| Vehicle | Connector | Pin | Circuit |
|--------------------|-----------|-----|---------|
| Expedition, | A | 4 | SIGRTN |
| Navigator | | 2 | VREF |
| F-150 3.3L, | B | 2 | SIGRTN |
| F-150 5.0L, | | 1 | VREF |
| Mustang 5.0L | A | 4 | SIGRTN |
| All other vehicles | | 3 | VREF |

Fuel Tank Pressure (FTP) Sensor Connector

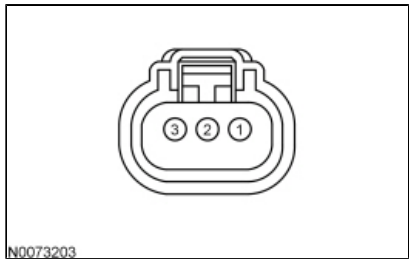
A



B

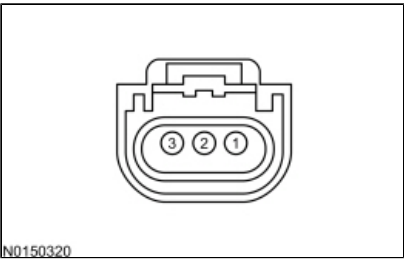


C



| Vehicle | Connector | Pin | Circuit |
|--|-----------|-----|---------|
| E-Series, F-650 / F-750, Motorhome / Stripped Chassis / Step Van, Ranger, Taurus, Transit, Transit Connect | A | 3 | VREF |
| | | 2 | SIGRTN |
| Ford GT | B | 3 | VREF |
| | | 2 | SIGRTN |
| All other vehicles | C | 3 | VREF |
| | | 2 | SIGRTN |

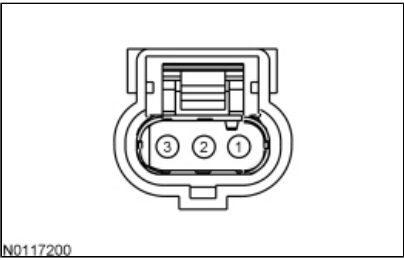
Generator Current Sensor Connector



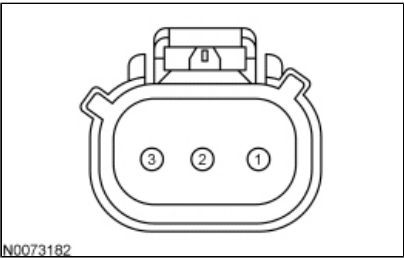
| Pin | Circuit |
|-----|--------------------------|
| 2 | SIGRTN (Signal Return) |
| 1 | VREF (Reference Voltage) |

Intake Manifold Runner Control Bank 1 (IMRC1) Sensor Connector

A



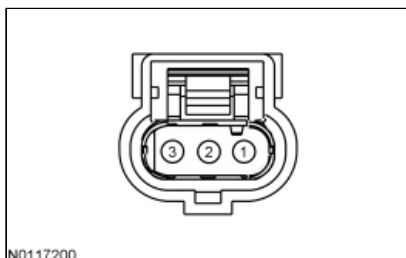
B



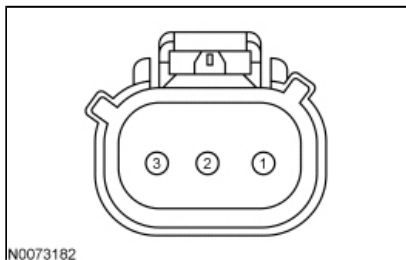
| Vehicle | Connector | Pin | Circuit |
|--------------------------------------|-----------|-----|---------|
| F-150, Mustang 5.0L | A | 1 | SIGRTN |
| | | 3 | VREF |
| F-Series Super Duty, Mustang 5.2L | B | 3 | SIGRTN |
| | | 2 | VREF |

Intake Manifold Runner Control Bank 2 (IMRC2) Sensor Connector

A



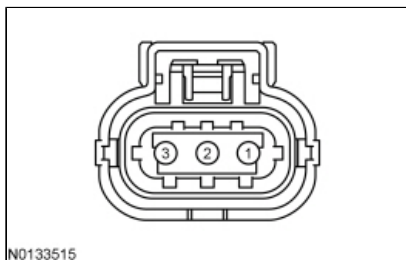
B



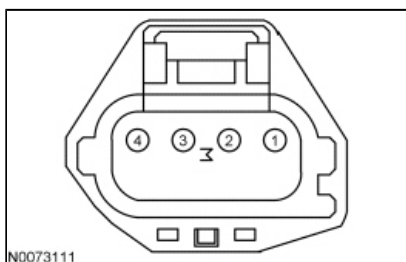
| Vehicle | Connector | Pin | Circuit |
|--------------------------------------|-----------|-----|---------|
| F-150, Mustang 5.0L | A | 1 | SIGRTN |
| | | 3 | VREF |
| F-Series Super Duty, Mustang 5.2L | B | 3 | SIGRTN |
| | | 2 | VREF |

Manifold Absolute Pressure (MAP) Sensor Connector

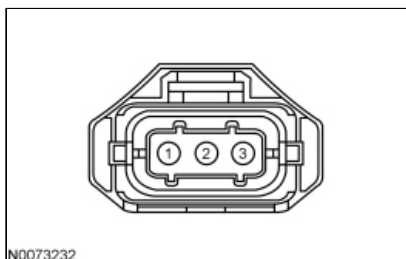
A



B



C

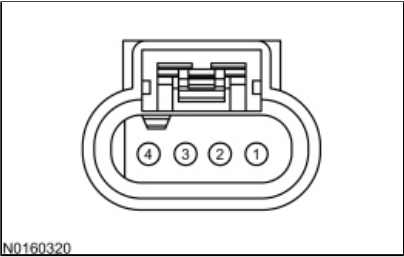


| Vehicle | Connector | Pin | Circuit |
|---|-----------|--------|----------------|
| Escape/Kuga 2.0L, Focus, MKC, MKT, Taurus | A | 2 3 | SIGRTN VREF |
| Fusion 2.0L, MKZ | C | 2 1 | SIGRTN VREF |
| All other vehicles | B | 4 | SIGRTN |

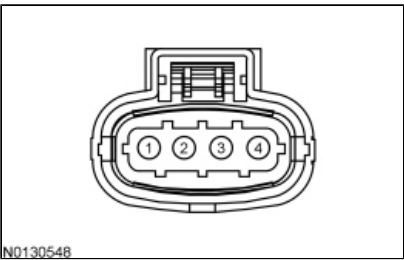
| Vehicle | Connector | Pin | Circuit |
|---------|-----------|-----|---------|
| | | 2 | VREF |

Manifold Absolute Pressure Temperature (MAPT) Sensor Connector

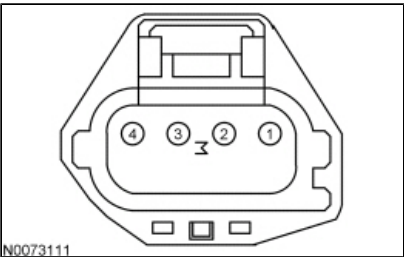
A



B



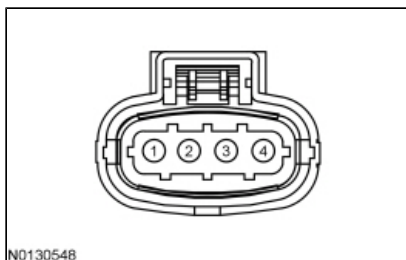
C



| Vehicle | Connector | Pin | Circuit |
|--|-----------|--------|----------------|
| Continental, EcoSport 1.5L, Edge 3.5L, Explorer 3.5L, | A | 4 2 | SIGRTN VREF |

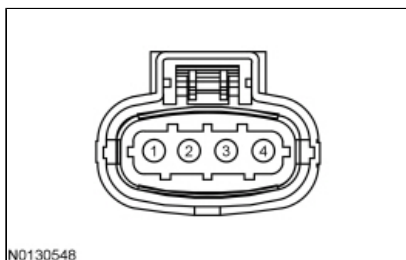
| Vehicle | Connector | Pin | Circuit |
|--|-----------|--------|----------------|
| Explorer 3.7L, F-150 3.3L, Flex 3.5L, MKT 3.7L, MKX, Taurus 3.5L, Transit 3.7L | | | |
| Ranger | C | 4 2 | SIGRTN VREF |
| All other vehicles | B | 1 3 | SIGRTN VREF |

Manifold Absolute Pressure/Charge Air Cooler Temperature (MAP/CACT) Sensor Connector

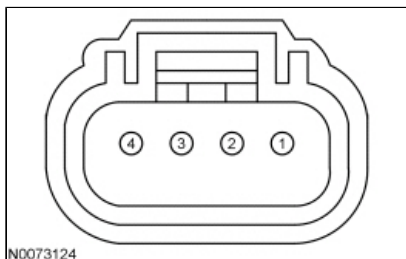


| Pin | Circuit |
|-----|--------------------------|
| 1 | SIGRTN (Signal Return) |
| 3 | VREF (Reference Voltage) |

Manifold Absolute Pressure/Intake Air Temperature 2 (MAP/IAT2) Sensor Connector



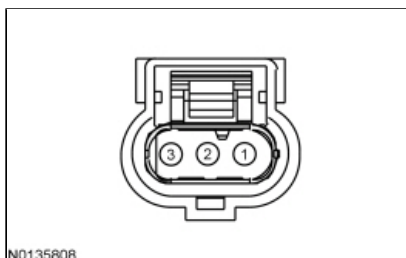
B



| Vehicle | Connector | Pin | Circuit |
|---|-----------|--------|----------------|
| Continental 2.0L, EcoSport, Escape/Kuga, Fiesta, MKC, Mustang | A | 1 3 | SIGRTN VREF |
| Edge 2.7L, Explorer 3.5L, F-150 2.7L, Flex, MKT, MKX 2.7L, Taurus, Transit | B | 4 2 | SIGRTN VREF |
| Explorer 2.3L | B | 2 1 | SIGRTN VREF |

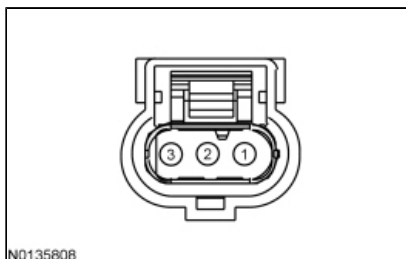
| Vehicle | Connector | Pin | Circuit |
|--------------------|-----------|-----|---------|
| All other vehicles | A | 4 | SIGRTN |
| | | 2 | VREF |

Particulate Filter Pressure Bank 1, Sensor 1 Connector



| Pin | Circuit |
|-----|--------------------------|
| 2 | SIGRTN (Signal Return) |
| 3 | VREF (Reference Voltage) |

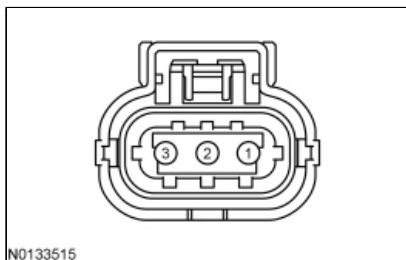
Particulate Filter Pressure Bank 2, Sensor 1 Connector



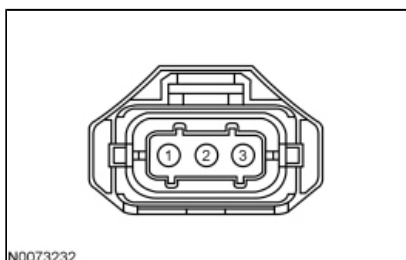
| Pin | Circuit |
|-----|--------------------------|
| 2 | SIGRTN (Signal Return) |
| 3 | VREF (Reference Voltage) |

Turbocharger Boost Pressure (TCBP) Sensor Connector

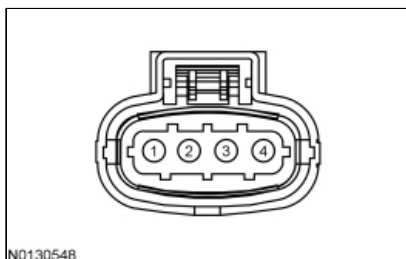
A



B



C

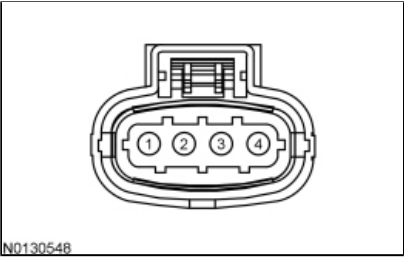


| Vehicle | Connector | Pin | Circuit |
|---|-----------|--------|----------------|
| Continental 2.0L, EcoSport, Explorer 2.3L, Focus 2.3L, Focus 1.0L, Mustang | A | 2 3 | SIGRTN VREF |
| Edge 2.0L, Escape/Kuga 1.5L, | B | 2 1 | SIGRTN VREF |

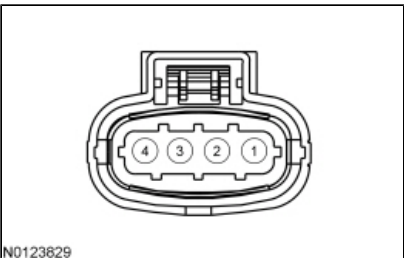
| Vehicle | Connector | Pin | Circuit |
|--|-----------|------------|--------------------|
| MKX 2.0L | | | |
| Escape/Kuga 2.0L, Fiesta 1.0L, MKC | C | 1 3 | SIGRTN VREF |
| Fusion 1.5L | A | 2 1 | SIGRTN VREF |

Turbocharger Boost Pressure/Charge Air Cooler Temperature (TCBP/CACT) Sensor Connector

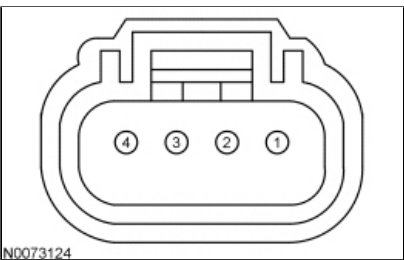
A



B

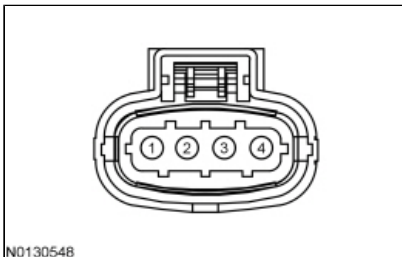


C



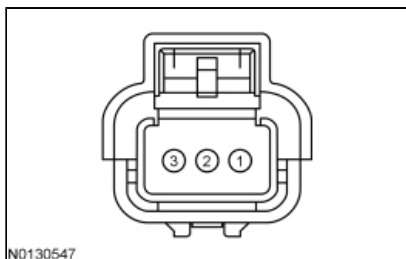
| Vehicle | Connector | Pin | Circuit |
|---|-----------|--------|----------------|
| Fiesta, Fusion 2.0L, MKC, MKZ 2.0L, Taurus 2.0L | A | 1 3 | SIGRTN VREF |
| Focus, MKT 2.0L | B | 1 3 | SIGRTN VREF |
| All other vehicles | C | 4 2 | SIGRTN VREF |

Turbocharger Intake Pressure And Temperature (TCIPT) Sensor Connector



| Pin | Circuit |
|-----|--------------------------|
| 1 | SIGRTN (Signal Return) |
| 3 | VREF (Reference Voltage) |

Wastegate Vacuum Sensor Connector



| Pin | Circuit |
|-----|--------------------------|
| 2 | SIGRTN (Signal Return) |
| 1 | VREF (Reference Voltage) |

Powertrain Control Module (PCM) Connector

For PCM connector views or reference values, refer to Section 6, Reference Values.

| Vehicle | Connector | Pin | Circuit |
|--|-----------|--|----------|
| Continental 2.7L, Continental 3.0L, Taurus GTDI 3.5L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B18, B37, B38, E20, E53 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B36 | APPRTN1 |
| | | E31 | ETCRTN |
| | | B11, B13, E8 | VREF |
| | | B10 | APPVREF2 |
| | | B12 | APPVREF1 |
| Continental 3.7L | 198 PIN | E7 | ETCREF |
| | | B97, B99 | VPWR |
| | | B51, B71, B90, E29, E40, E49, E51, E54 | SIGRTN |
| | | B59 | APPRTN2 |
| | | B35 | APPRTN1 |
| | | E23 | ETCRTN |

| Vehicle | Connector | Pin | Circuit |
|--------------------------------------|-----------|---|----------|
| | | E34 | VREF |
| | | B40 | APPVREF2 |
| | | B36 | APPVREF1 |
| | | E8 | ETCREF |
| E-Series 6.2L | 198 PIN | B97, B99 | VPWR |
| | | B30, B51, B54, B71, B90, E49 | SIGRTN |
| | | B59 | APPRTN2 |
| | | B35 | APPRTN1 |
| | | E23 | ETCRTN |
| | | B29, B52 | VREF |
| | | B40 | APPVREF2 |
| | | B36 | APPVREF1 |
| | | E8 | ETCREF |
| E-Series 6.8L | 198 PIN | B97, B99 | VPWR |
| | | B30, B51, B54, B71, B90, E49, E54 | SIGRTN |
| | | B59 | APPRTN2 |
| | | B35 | APPRTN1 |
| | | E23 | ETCRTN |
| | | B29, B52 | VREF |
| | | B40 | APPVREF2 |
| | | B36 | APPVREF1 |
| | | E8 | ETCREF |
| EcoSport 1.0L Automatic Transmission | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B18, B19, B38, B9, E19, E20, E22, E53, E54 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B36 | APPRTN1 |
| | | E31 | ETCRTN |
| | | B11, B13, E6, E8 | VREF |

| Vehicle | Connector | Pin | Circuit |
|--------------------------------------|-----------|--|--|
| | | B10 | APPVREF2 |
| | | B12 | APPVREF1 |
| | | E7 | ETCREF |
| EcoSport 1.0L Manual Transmission | 198 PIN | B101, B102, B103 B17, B19, B34, E10, E19, E20, E54 B35 B36 E18 B11, E3, E7 B10 B12 E5 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| EcoSport 1.5L Automatic Transmission | 198 PIN | B97, B99 B13, B15, B33, B51, B53, E12, E29, E35, E53 B35 B59 E23 B52, E11, E28, E34 B36 B40 E8 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| EcoSport 1.5L Manual Transmission | 112 PIN | B55, B56 B19, B8, B9, E1, E2, E23, E3, E38, E4, E44, E5 B12 B3 E6 E1, E10, E11, E7, E9 B11 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 |

| Vehicle | Connector | Pin | Circuit |
|--|-----------|---|----------|
| | | B2 | APPVREF1 |
| | | E8 | ETCREF |
| EcoSport 2.0L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B18, B38, B9, E20, E35, E53, E56, E7 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B36 | APPRTN1 |
| | | E31 | ETCRTN |
| | | B11, B13, E5, E6, E8 | VREF |
| | | B10 | APPVREF2 |
| | | B12 | APPVREF1 |
| | | E7 | ETCREF |
| Edge 2.0L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B18, B19, B38, B7, E20, E53 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B36 | APPRTN1 |
| | | E31 | ETCRTN |
| | | B11, B13, E6, E8 | VREF |
| | | B10 | APPVREF2 |
| | | B12 | APPVREF1 |
| | | E7 | ETCREF |
| Edge 2.7L, Fusion 2.7L, MKZ 3.0L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B18, B19, B37, B38, B7, E20, E53 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B36 | APPRTN1 |
| | | E31 | ETCRTN |
| | | B11, B13, E6, E8 | VREF |
| | | B10 | APPVREF2 |
| | | B12 | APPVREF1 |

| Vehicle | Connector | Pin | Circuit |
|------------------|-----------|---|----------|
| | | E7 | ETCREF |
| Edge 3.5L | 198 PIN | B97, B99 | VPWR |
| | | B2, B51, B71, B90, E29, E40, E49, E54, E71 | SIGRTN |
| | | B59 | APPRTN2 |
| | | B35 | APPRTN1 |
| | | E23 | ETCRTN |
| | | B52, B66, E34 | VREF |
| | | B40 | APPVREF2 |
| | | B36 | APPVREF1 |
| | | E8 | ETCREF |
| Escape/Kuga 1.5L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B24, B25, B26, B73, E13, E14, E20, E26, E27, E29 | SIGRTN |
| | | B27 | APPRTN2 |
| | | B15 | APPRTN1 |
| | | E12 | ETCRTN |
| | | B11, B13, B17, E11, E6, E7, E8, E9 | VREF |
| | | B28 | APPVREF2 |
| | | B16 | APPVREF1 |
| | | E10 | ETCREF |
| Escape/Kuga 2.0L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B17, B18, B19, B34, B38, E20, E53 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B36 | APPRTN1 |
| | | E31 | ETCRTN |
| | | B11, B13, E6, E8 | VREF |
| | | B10 | APPVREF2 |
| | | B12 | APPVREF1 |

| Vehicle | Connector | Pin | Circuit |
|--|-----------|--|----------|
| | | E7 | ETCREF |
| Escape/Kuga 2.5L | 198 PIN | B97, B99 | VPWR |
| | | B30, B33, B54, B56, B71, E35 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B59 | APPRTN1 |
| | | E23 | ETCRTN |
| | | B52, B66, E34 | VREF |
| | | B36 | APPVREF2 |
| | | B40 | APPVREF1 |
| | | E8 | ETCREF |
| Expedition | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B17, B18, B30, B34, B37, B38, B75, B94, E10, E20, E29, E32, E53 | SIGRTN |
| | | B15 | APPRTN2 |
| | | B19 | APPRTN1 |
| | | E35 | ETCRTN |
| | | B11, B13, B5, E2, E3, E5, E6, E8 | VREF |
| | | B14 | APPVREF2 |
| | | B18 | APPVREF1 |
| | | E4 | ETCREF |
| Explorer 2.3L, MKT 2.0L, Taurus 2.0L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B18, B38, E20, E53 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B36 | APPRTN1 |
| | | E31 | ETCRTN |
| | | B11, B13, E6, E8 | VREF |
| | | B10 | APPVREF2 |
| | | B12 | APPVREF1 |

| Vehicle | Connector | Pin | Circuit |
|--|-----------|--|----------|
| | | E7 | ETCREF |
| Explorer GTDI 3.5L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B18, B37, B38, E20, E53 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B36 | APPRTN1 |
| | | E4 | ETCRTN |
| | | B11, B13, E8 | VREF |
| | | B10 | APPVREF2 |
| | | B12 | APPVREF1 |
| | | E35 | ETCREF |
| Explorer TiVCT 3.5L, MKX 3.7L, Taurus TiVCT 3.5L | 198 PIN | B97, B99 | VPWR |
| | | B51, B56, B71, B90, E29, E40, E49, E54 | SIGRTN |
| | | B59 | APPRTN2 |
| | | B35 | APPRTN1 |
| | | E23 | ETCRTN |
| | | B52, B66, E34 | VREF |
| | | B40 | APPVREF2 |
| | | B36 | APPVREF1 |
| | | E8 | ETCREF |
| Explorer 3.7L | 198 PIN | B97, B99 | VPWR |
| | | B51, B56, B71, B90, E29, E40, E49, E54 | SIGRTN |
| | | B59 | APPRTN2 |
| | | B35 | APPRTN1 |
| | | E23 | ETCRTN |
| | | B5, B52, B66, E34 | VREF |
| | | B40 | APPVREF2 |
| | | B36 | APPVREF1 |
| | | E8 | ETCREF |

| Vehicle | Connector | Pin | Circuit |
|------------|-----------|---|--|
| F-150 2.7L | 306 PIN | B1, B16, B2 B17, B18, B34, B37, B38, B43, E113, E121, E13, E47, E5, E91, E99, T84, T85 B72 B87 E114 E115, E116, E118, E120 B71 B86 E117 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| F-150 3.3L | 306 PIN | B1, B16, B2 B43, E113, E13, E47, E5, E91, E99, T84, T85 B72 B87 E114 E116, E118, E120 B71 B86 E117 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| F-150 3.5L | 198 PIN | B101, B102, B103 B16, B17, B18, B30, B34, B37, B38, B7, B75, B94, E10, E20, E29, E32, E53 B15 B19 E35 B11, B13, B5, E2, E3, E5, E6, E8 B14 B18 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |

| Vehicle | Connector | Pin | Circuit |
|--------------------------|-----------|---|----------|
| | | E4 | |
| F-150 5.0L | 306 PIN | B1, B16, B2 | VPWR |
| | | B43, E113, E13, E47, E5, E91, E99, T84, T85 | SIGRTN |
| | | B72 | APPRTN2 |
| | | B87 | APPRTN1 |
| | | E114 | ETCRTN |
| | | E115, E116, E118, E120 | VREF |
| | | B71 | APPVREF2 |
| | | B86 | APPVREF1 |
| | | E117 | ETCREF |
| F-650 / F-750 | 198 PIN | B97, B99 | VPWR |
| | | B54, B71, E49, E54 | SIGRTN |
| | | B59 | APPRTN2 |
| | | B35 | APPRTN1 |
| | | E23 | ETCRTN |
| | | B52, B66 | VREF |
| | | B40 | APPVREF2 |
| | | B36 | APPVREF1 |
| | | E8 | ETCREF |
| F-Series Super Duty 6.2L | 198 PIN | B97, B99 | VPWR |
| | | B51, B56, B71, B90, E29, E32, E49, T26 | SIGRTN |
| | | B59 | APPRTN2 |
| | | B35 | APPRTN1 |
| | | E23 | ETCRTN |
| | | B52, B66, E34 | VREF |
| | | B40 | APPVREF2 |
| | | B36 | APPVREF1 |
| | | E8 | ETCREF |

| Vehicle | Connector | Pin | Circuit |
|-----------------------------|-----------|---|----------|
| F-Series Super Duty 6.8L | 198 PIN | B97, B99 | VPWR |
| | | B30, B51, B56, B71, E29, E32, E49, T26 | SIGRTN |
| | | B59 | APPRTN2 |
| | | B35 | APPRTN1 |
| | | E23 | ETCRTN |
| | | B52, B66 | VREF |
| | | B40 | APPVREF2 |
| | | B36 | APPVREF1 |
| | | E8 | ETCREF |
| Fiesta 1.0L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B17, B19, B37, B40, B9, E1, E10, E19, E20, E22, E54 | SIGRTN |
| | | E18 | ETCRTN |
| | | B13, B14, E3, E7 | VREF |
| | | E5 | ETCREF |
| Fiesta GTDI 1.6L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B17, B19, B37, B40, B9, E1, E10, E19, E20, E22, E49, E54 | SIGRTN |
| | | E18 | ETCRTN |
| | | B13, B14, E3, E7 | VREF |
| | | E5 | ETCREF |
| Fiesta TiVCT 1.6L | 128 PIN | B11, B12, E13, E37 | VPWR |
| | | B38, B40, E3, E6, E9, T27, T29 | SIGRTN |
| | | E4 | ETCRTN |
| | | B14, B16, E30, T11, T13 | VREF |
| | | E28 | ETCREF |
| Flex GTDI 3.5L, MKT 3.5L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B18, B37, B38, E20, E41, E53 | SIGRTN |
| | | B35 | APPRTN2 |

| Vehicle | Connector | Pin | Circuit |
|------------------------------|-----------|--|--|
| | | B36 E31 B11, B13, E8 B10 B12 E7 | APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| Flex TiVCT 3.5L, MKT 3.7L | 198 PIN | B97, B99 B51, B56, B71, B90, E29, E40, E41, E49, E54 B59 B35 E23 B52, B66, E34 B40 B36 E8 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| Focus 1.0L | 198 PIN | B101, B102, B103 B16, B18, B19, B38, B74, E20, E53 B35 B36 E31 B11, B13, E6, E8 B10 B12 E7 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| Focus GDI 2.0L | 154 PIN | B5, B6 B21, B34, E10, E32, E33, E34, E36, E44, E46, E47 B38 B36 | VPWR SIGRTN APPRTN2 APPRTN1 |

| Vehicle | Connector | Pin | Circuit |
|-----------------|-----------|---|--|
| | | E58 B31, B7, E15, E16, E18, E23 B46 B53 E19 | ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| Focus GTDI 2.0L | 198 PIN | B101, B102, B103 B16, B18, B19, B37, E20, E36, E53 B35 B36 E31 B11, E6, E8 B10 B12 E7 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| Focus 2.3L | 198 PIN | B101, B102, B103 B16, B18, B19, B37, B38, E20, E32, E53 B35 B36 E31 B11, B13, E5, E6, E8 B10 B12 E7 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| Ford GT | 198 PIN | B101, B102, B103 B18, B37, B38, B9, E20, E32, E53, E56 B35 B36 E31 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN |

| Vehicle | Connector | Pin | Circuit |
|-------------|-----------|--|--|
| | | B11, E5, E6, E8 B10 B12 E7 | VREF APPVREF2 APPVREF1 ETCREF |
| Fusion 2.5L | 198 PIN | B97, B99 B33, B54, B56, B71, E35, T41 B35 B59 E23 B66, E34 B36 B40 E8 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| KA 1.0L | 128 PIN | B36, E24 E14, E15, E7, E8, T17, T20, T21, T22 B33 B32 T19 B26, E2, T26, T28, T30 B46 B44 T27 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| KA 1.5L | 128 PIN | B36, E24 E15, E7, E8, T17, T20, T21, T22 B33 B32 T19 B26, T26, T28, T30 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF |

| Vehicle | Connector | Pin | Circuit |
|---|-----------|-----------------------------------|----------|
| | | B46 | APPVREF2 |
| | | B44 | APPVREF1 |
| | | T27 | ETCREF |
| MKC | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B18, B19, B37, B38, E20, E53 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B36 | APPRTN1 |
| | | E31 | ETCRTN |
| | | B11, E6, E8 | VREF |
| | | B10 | APPVREF2 |
| | | B12 | APPVREF1 |
| | | E7 | ETCREF |
| MKX 2.7L | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B18, B37, B38, E20, E53 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B36 | APPRTN1 |
| | | E31 | ETCRTN |
| | | B13, E8 | VREF |
| | | B10 | APPVREF2 |
| | | B12 | APPVREF1 |
| | | E7 | ETCREF |
| Motorhome / Stripped Chassis / Step Van | 198 PIN | B97, B99 | VPWR |
| | | B54, B56, B71, B90, E29, E49, T26 | SIGRTN |
| | | B59 | APPRTN2 |
| | | B35 | APPRTN1 |
| | | E23 | ETCRTN |
| | | B52, B66 | VREF |
| | | B40 | APPVREF2 |

| Vehicle | Connector | Pin | Circuit |
|--------------|-----------|---|----------|
| | | B36 | APPVREF1 |
| | | E8 | ETCREF |
| Mustang 2.3L | 198 PIN | B100, B101, B102 | VPWR |
| | | B17, B18, B19, B36, B37, B38, B55, E13, E14, E20, E32, E5, E53, E57 | SIGRTN |
| | | B19 | APPRTN2 |
| | | B18 | APPRTN1 |
| | | E16 | ETCRTN |
| | | B11, B13, B16, E19, E30, E5, E6, E8 | VREF |
| | | B38 | APPVREF2 |
| | | B37 | APPVREF1 |
| | | E10 | ETCREF |
| Mustang 5.0L | 306 PIN | B1, B16, B2 | VPWR |
| | | B26, B43, B51, B54, B56, B58, E113, E13, E22, E32, E40, E47, E49, E5, E54, E91, E99, T57, T71, T84, | SIGRTN |
| | | T85 | APPRTN2 |
| | | B72 | APPRTN1 |
| | | B87 | ETCRTN |
| | | E114 | VREF |
| | | B52, B66, B81, E115, E118, E120, E34, T81 | APPVREF2 |
| | | B71 | APPVREF1 |
| | | B86 | ETCREF |
| | | E117 | |
| Mustang 5.2L | 198 PIN | B97, B99 | VPWR |
| | | B51, B54, B71, B90, E40, E49, E54 | SIGRTN |
| | | B59 | APPRTN2 |
| | | B35 | APPRTN1 |
| | | E23 | ETCRTN |

| Vehicle | Connector | Pin | Circuit |
|-------------|-----------|--|--|
| | | B52, E34 B40 B36 E8 | VREF APPVREF2 APPVREF1 ETCREF |
| Navigator | 198 PIN | B101, B102, B103 B16, B17, B18, B30, B34, B37, B38, B75, B94, E10, E20, E29, E32, E53 B15 B19 E35 B11, B13, B5, E2, E5, E6, E8 B14 B18 E4 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| Ranger | 128 PIN | B11, B12 B33, B38, B40, E3, E6, E9, T29 B41 B42 E4 B14, B16, T18 B17 B18 E28 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| Taurus 3.7L | 198 PIN | B97, B99 B51, B56, B71, B90, E29, E40, E49, E54, T41 B59 B35 E23 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN |

| Vehicle | Connector | Pin | Circuit |
|-----------------|-----------|--|--|
| | | B52, B55, B61, E34, E35, E57 B40 B36 E8 | VREF APPVREF2 APPVREF1 ETCREF |
| Transit 3.5L | 198 PIN | B101, B102, B103 B18, B37, B38, E20, E53 B35 B36 E31 B11, E8 B10 B12 E7 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| Transit 3.7L | 198 PIN | B97, B99 B51, B71, B90, E29, E40, E49, E54 B59 B35 E23 E29, E34 B40 B36 E8 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF APPVREF2 APPVREF1 ETCREF |
| Transit Connect | 198 PIN | B97, B99 B30, B35, B54, B56, B71, E35 B35 B59 E23 E34 | VPWR SIGRTN APPRTN2 APPRTN1 ETCRTN VREF |

| Vehicle | Connector | Pin | Circuit |
|--------------------|-----------|------------------------------|----------|
| | | B36 | APPVREF2 |
| | | B40 | APPVREF1 |
| | | E8 | ETCREF |
| All other vehicles | 198 PIN | B101, B102, B103 | VPWR |
| | | B16, B18, B19, B38, E20, E53 | SIGRTN |
| | | B35 | APPRTN2 |
| | | B36 | APPRTN1 |
| | | E31 | ETCRTN |
| | | B11, B13, E6, E8 | VREF |
| | | B10 | APPVREF2 |
| | | B12 | APPVREF1 |
| | | E7 | ETCREF |

C1 CHECK THE REFERENCE VOLTAGE TO SIGNAL RETURN

Note: Diagnostic trouble codes (DTCs) P0642, P0643, P06A6, P06A7 and P06A8 are set due to VREF circuit concerns only. When diagnosing DTC P0642, P0643, P06A6, P06A7 or P06A8, follow the path for VREF concerns. The DTCs P0652 and P0653 are set due to ETCREF circuit concerns only. When diagnosing DTC P0652 or P0653, follow the path for ETCREF concerns.

- Ignition OFF.
- Suspect Sensor connector disconnected.
- Ignition ON, engine OFF.
- For ETCREF concerns.
- Measure the voltage between:

| (+) ETBTPS Connector, Harness Side | (-) ETBTPS Connector, Harness Side |
|--------------------------------------|--------------------------------------|
| ETCREF | ETCRTN |

- For APPVREF concerns.
- Measure the voltage between:

| (+) APP Sensor Connector, Harness Side | (-) APP Sensor Connector, Harness Side |
|--|--|
| APPVREF1 | APPRTN1 |
| APPVREF2 | APPRTN2 |

- For VREF concerns.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) Suspect Sensor Connector, Harness Side |
|--|--|
| VREF | SIGRTN |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|-----------------------------|
| Yes | GO to C37 . |
| No | GO to C2 . |

C2 CHECK THE REFERENCE VOLTAGE TO GROUND

- For ETCREF concerns.
- Measure the voltage between:

| (+) ETBTPS Connector, Harness Side | (-) |
|--------------------------------------|--------|
| ETCREF | Ground |

- For APPVREF concerns.
- Measure the voltage between:

| (+) APP Sensor Connector, Harness Side | (-) |
|--|--------|
| APPVREF1 | Ground |
| APPVREF2 | Ground |

- For VREF concerns.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|-----------------------------|
| Yes | GO to C36 . |
| No | GO to C3 . |

C3 CHECK THE REFERENCE VOLTAGE WITH ALL SENSORS DISCONNECTED

Note: Refer to the *Sensors Connected To Reference Voltage Chart* at the beginning of this pinpoint test and the *Wiring Diagrams Manual Electronic Engine Controls Cell* to identify the sensors connected to VREF, ETCREF and APPVREF.

- Ignition OFF.
- Disconnect all of the sensors connected to the reference voltage circuits.
- Ignition ON, engine OFF.
- Measure the voltage at the sensor disconnected in C1.
- For ETCREF concerns.
- Measure the voltage between:

| (+) ETBTPS Connector, Harness Side | (-) |
|--------------------------------------|--------|
| ETCREF | Ground |

- For APPVREF concerns.
- Measure the voltage between:

| (+) APP Sensor Connector, Harness Side | (-) |
|--|--------|
| APPVREF1 | Ground |
| APPVREF2 | Ground |

- For VREF concerns.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|----------------------------|
| Yes | GO to C8 . |
| No | GO to C4 . |

C4 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR AN OPEN

- Ignition OFF.
- PCM connector disconnected.
- For ETCREF concerns.
- Measure the resistance between:

| (+) ETBTPS Connector, Harness Side | (-) PCM Connector, Harness Side |
|--------------------------------------|-----------------------------------|
| ETCREF | ETCREF |

- For APPVREF concerns.
- Measure the resistance between:

| (+) APP Sensor Connector, Harness Side | (-) PCM Connector, Harness Side |
|--|-----------------------------------|
| APPVREF1 | APPVREF1 |
| APPVREF2 | APPVREF2 |

- For VREF concerns.
- Measure the resistance between:

| (+) Suspect Sensor Connector, Harness Side | (-) PCM Connector, Harness Side |
|--|-----------------------------------|
| VREF | VREF |

Is the resistance less than 5 ohms?

| | |
|------------|--|
| Yes | GO to C5 . |
| No | REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test. |

C5 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO GROUND

- For APPVREF or ETCREF concerns.
- Measure the resistance between:

| (+) PCM Connector, Harness Side | (-) PCM Connector, Harness Side |
|-----------------------------------|-----------------------------------|
| ETCREF | ETCRTN |
| APPVREF1 | APPRTN1 |
| APPVREF2 | APPRTN2 |
| APPVREF1 | APPRTN2 |
| APPVREF2 | APPRTN1 |

- Measure the resistance between:

| (+) PCM Connector, Harness Side | (-) |
|-----------------------------------|--------|
| ETCREF | Ground |
| APPVREF1 | Ground |
| APPVREF2 | Ground |

- For VREF concerns.
- Measure the resistance between:

| (+) PCM Connector, Harness Side | (-) PCM Connector, Harness Side |
|-----------------------------------|-----------------------------------|
| VREF | SIGRTN |

- Measure the resistance between:

| (+) PCM Connector, Harness Side | (-) |
|-----------------------------------|--------|
| VREF | Ground |

Are the resistances greater than 10K ohms?

| | |
|------------|---|
| Yes | GO to C6 . |
| No | REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test. |

C6 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO VPWR

- For ETCREF concerns.
- Measure the resistance between:

| (+) PCM Connector, Harness Side | (-) PCM Connector, Harness Side |
|-----------------------------------|-----------------------------------|
| ETCREF | VPWR |

- For APPVREF concerns.
- Measure the resistance between:

| (+) PCM Connector, Harness Side | (-) PCM Connector, Harness Side |
|-----------------------------------|-----------------------------------|
| APPVREF1 | VPWR |
| APPVREF2 | VPWR |

- For VREF concerns.
- Measure the resistance between:

| (+) PCM Connector, Harness Side | (-) PCM Connector, Harness Side |
|-----------------------------------|-----------------------------------|
| VREF | VPWR |

Is the resistance greater than 10K ohms?

| | |
|------------|---|
| Yes | GO to C7 . |
| No | REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test. |

C7 CHECK THE REFERENCE VOLTAGE CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition ON, engine OFF.
- For ETCREF concerns.
- Measure the voltage between:

| (+) PCM Connector, Harness Side | (-) |
|-----------------------------------|--------|
| ETCREF | Ground |

- For APPVREF concerns.
- Measure the voltage between:

| (+) PCM Connector, Harness Side | (-) |
|-----------------------------------|--------|
| APPVREF1 | Ground |
| APPVREF2 | Ground |

- For VREF concerns.
- Measure the voltage between:

| (+) PCM Connector, Harness Side | (-) |
|-----------------------------------|--------|
| VREF | Ground |

Is any voltage present?

| | |
|------------|---|
| Yes | REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to C38 . |

C8 CHECK THE REFERENCE VOLTAGE WITH THE ETBTPS CONNECTED

Note: *If this sensor was used for the measurement in C3, GO to [C9](#).*

- Ignition OFF.
- ETBTPS connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) APP Sensor Connector, Harness Side | (-) |
|--|--------|
| APPVREF1 | Ground |
| APPVREF2 | Ground |

Are the voltages between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C9 . |
| No | <p>INSTALL a new ETBTPS. REFER to the Workshop Manual Section 303-04, Fuel Charging and Controls or Section 303-14, Electronic Engine Controls.</p> <p>Clear the PCM DTCs. REPEAT the self-test.</p> |

C9 CHECK THE REFERENCE VOLTAGE WITH THE APP SENSOR CONNECTED

Note: *If this sensor was used for the measurement in C3, GO to [C10](#).*

- Ignition OFF.
- APP Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) ETBTPS Connector, Harness Side | (-) |
|--------------------------------------|--------|
| ETCREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C10 . |
| No | <p>INSTALL a new APP sensor. REFER to the Workshop Manual Section 310-02, Acceleration Control.</p> <p>Clear the PCM DTCs. REPEAT the self-test.</p> |

C10 CHECK THE REFERENCE VOLTAGE WITH THE MAP SENSOR CONNECTED

Note: *If the vehicle is not equipped with a MAP sensor or if this sensor was used for the VREF measurement in C3, GO to [C11](#).*

- Ignition OFF.
- MAP Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|---|
| Yes | GO to C11 . |
| No | INSTALL a new MAP sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

C11 CHECK THE REFERENCE VOLTAGE WITH THE TCBP/CACT SENSOR CONNECTED

Note: *If the vehicle is not equipped with a TCBP/CACT sensor or if this sensor was used for the VREF measurement in C3, GO to [C12](#).*

- Ignition OFF.
- TCBP/CACT Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|---|
| Yes | GO to C12 . |
| No | INSTALL a new TCBP/CACT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

C12 CHECK THE REFERENCE VOLTAGE WITH THE MAP/IAT2 SENSOR CONNECTED

Note: *If the vehicle is not equipped with a MAP/IAT2 sensor or if this sensor was used for the VREF measurement in C3, GO to [C13](#).*

- Ignition OFF.
- MAP/IAT2 Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C13 . |
| No | INSTALL a new MAP/IAT2 sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

C13 CHECK THE REFERENCE VOLTAGE WITH THE FRP SENSOR CONNECTED

Note: *If the vehicle is not equipped with a FRP sensor or if this sensor was used for the VREF measurement in C3, GO to [C14](#).*

- Ignition OFF.
- FRP Sensor connector connected.

- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|---|
| Yes | GO to C14 . |
| No | INSTALL a new FRP sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

C14 CHECK THE REFERENCE VOLTAGE WITH THE CRANKCASE PRESSURE SENSOR CONNECTED

Note: *If the vehicle is not equipped with a crankcase pressure sensor or if this sensor was used for the VREF measurement in C3, GO to [C15](#).*

- Ignition OFF.
- Crankcase Pressure Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C15 . |
| No | INSTALL a new Crankcase Pressure sensor. REFER to the Workshop Manual Section 303-08, Engine Emission Control. |

| | |
|--|---|
| | Clear the PCM DTCs. REPEAT the self-test. |
|--|---|

C15 CHECK THE REFERENCE VOLTAGE WITH THE IMRC1 SENSOR CONNECTED

Note: *If the vehicle is not equipped with an IMRC1 sensor or if this sensor was used for the VREF measurement in C3, GO to [C16](#).*

- Ignition OFF.
- IMRC1 Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|---|
| Yes | GO to C16 . |
| No | INSTALL a new IMRC1 sensor. REFER to the Workshop Manual Section 303-01, Engine. Clear the PCM DTCs. REPEAT the self-test. |

C16 CHECK THE REFERENCE VOLTAGE WITH THE IMRC2 SENSOR CONNECTED

Note: *If the vehicle is not equipped with an IMRC2 sensor or if this sensor was used for the VREF measurement in C3, GO to [C17](#).*

- Ignition OFF.
- IMRC2 Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C17 . |
| No | <p>INSTALL a new IMRC2 sensor. REFER to the Workshop Manual Section 303-01, Engine.</p> <p>Clear the PCM DTCs. REPEAT the self-test.</p> |

C17 CHECK THE REFERENCE VOLTAGE WITH THE CPP SENSOR CONNECTED

Note: If the vehicle is not equipped with a CPP sensor or if this sensor was used for the VREF measurement in C3, GO to [C18](#).

- Ignition OFF.
- CPP Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C18 . |
| No | <p>INSTALL a new CPP sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls.</p> <p>Clear the PCM DTCs. REPEAT the self-test.</p> |

C18 CHECK THE REFERENCE VOLTAGE WITH THE ACP TRANSDUCER SENSOR

CONNECTED

Note: *If the vehicle is not equipped with an ACP transducer sensor or if this sensor was used for the VREF measurement in C3, GO to [C19](#).*

- Ignition OFF.
- Air Conditioning Pressure (ACP) Transducer Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C19 . |
| No | INSTALL a new Air Conditioning Pressure (ACP) Transducer Sensor. Clear the PCM DTCs. REPEAT the self-test. |

C19 CHECK THE REFERENCE VOLTAGE WITH THE FUEL PRESSURE SENSOR CONNECTED

Note: *If the vehicle is not equipped with a fuel pressure sensor or if this sensor was used for the VREF measurement in C3, GO to [C20](#).*

- Ignition OFF.
- Fuel Pressure Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C20 . |
| No | INSTALL a new Fuel Pressure Sensor. REFER to the Workshop Manual Section 310-01, Fuel Tank and Lines. Clear the PCM DTCs. REPEAT the self-test. |

C20 CHECK THE REFERENCE VOLTAGE WITH THE CKP SENSOR CONNECTED

Note: *If the vehicle is not equipped with a CKP sensor or if this sensor was used for the VREF measurement in C3, GO to [C21](#).*

- Ignition OFF.
- CKP Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|---|
| Yes | GO to C21 . |
| No | INSTALL a new CKP sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

C21 CHECK THE REFERENCE VOLTAGE WITH THE CMP SENSOR CONNECTED

Note: *If the vehicle is not equipped with a CMP sensor or if this sensor was used for the VREF measurement in C3, GO to [C22](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.

- CMP Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C22 . |
| No | <p>INSTALL a new CMP sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls.</p> <p>Clear the PCM DTCs. REPEAT the self-test.</p> |

C22 CHECK THE REFERENCE VOLTAGE WITH THE WASTEGATE VACUUM SENSOR CONNECTED

Note: *If the vehicle is not equipped with a wastegate vacuum sensor or if this sensor was used for the VREF measurement in C3, GO to [C23](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.
- Wastegate Vacuum Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|---|
| Yes | GO to C23 . |
| No | <p>INSTALL a new Wastegate Vacuum Sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls.</p> <p>Clear the PCM DTCs. REPEAT the self-test.</p> |

C23 CHECK THE REFERENCE VOLTAGE WITH THE MAPT SENSOR CONNECTED

Note: *If the vehicle is not equipped with a MAPT sensor or if this sensor was used for the VREF measurement in C3, GO to [C24](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.
- MAPT Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|---|
| Yes | GO to C24 . |
| No | <p>INSTALL a new MAPT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls.</p> <p>Clear the PCM DTCs. REPEAT the self-test.</p> |

C24 CHECK THE REFERENCE VOLTAGE WITH THE GENERATOR CURRENT SENSOR CONNECTED

Note: *If the vehicle is not equipped with a generator current sensor or if this sensor was used for the VREF measurement in C3, GO to [C25](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.

- Generator Current Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C25 . |
| No | <p>INSTALL a new Generator Current sensor. REFER to the Workshop Manual Section 414-01, Battery, Mounting and Cables.</p> <p>Clear the PCM DTCs. REPEAT the self-test.</p> |

C25 CHECK THE REFERENCE VOLTAGE WITH THE MAP/CACT SENSOR CONNECTED

Note: *If the vehicle is not equipped with a MAP/CACT sensor or if this sensor was used for the VREF measurement in C3, GO to [C26](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.
- MAP/CACT Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|-----------------------------|
| Yes | GO to C26 . |
|------------|-----------------------------|

| | |
|-----------|---|
| No | <p>INSTALL a new MAP/CACT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls.</p> <p>Clear the PCM DTCs. REPEAT the self-test.</p> |
|-----------|---|

C26 CHECK THE REFERENCE VOLTAGE WITH THE TCBP SENSOR CONNECTED

Note: *If the vehicle is not equipped with a TCBP sensor or if this sensor was used for the VREF measurement in C3, GO to [C27](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.
- TCBP Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C27 . |
| No | INSTALL a new TCBP sensor. Clear the PCM DTCs. REPEAT the self-test. |

C27 CHECK THE REFERENCE VOLTAGE WITH THE FRPT SENSOR CONNECTED

Note: *If the vehicle is not equipped with a FRPT sensor or if this sensor was used for the VREF measurement in C3, GO to [C28](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.
- FRPT Sensor connector connected.
- Ignition ON, engine OFF.

- Measure the voltage between:

| | |
|--|--------|
| (+) Suspect Sensor Connector, Harness Side | (-) |
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C28 . |
| No | INSTALL a new FRPT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

C28 CHECK THE REFERENCE VOLTAGE WITH THE BRAKE VACUUM SENSOR CONNECTED

Note: *If the vehicle is not equipped with a brake vacuum sensor or if this sensor was used for the VREF measurement in C3, GO to [C29](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.
- Brake Vacuum Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| | |
|--|--------|
| (+) Suspect Sensor Connector, Harness Side | (-) |
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C29 . |
| No | INSTALL a new Brake Vacuum sensor. Clear the PCM DTCs. REPEAT the self-test. |

C29 CHECK THE REFERENCE VOLTAGE WITH THE PARTICULATE FILTER PRESSURE BANK 1, SENSOR 1 CONNECTED

Note: If the vehicle is not equipped with a particulate filter pressure bank 1, sensor 1 or if this sensor was used for the VREF measurement in C3, GO to [C30](#).

Note: Only measure the circuits that apply to the vehicle being diagnosed.

- Ignition OFF.
- Particulate Filter Pressure Bank 1, Sensor 1 connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|---|
| Yes | GO to C31 . |
| No | INSTALL a new Particulate Filter Pressure Bank 1, Sensor 1. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

C30 CHECK THE REFERENCE VOLTAGE WITH THE PARTICULATE FILTER PRESSURE BANK 2, SENSOR 1 CONNECTED

Note: If the vehicle is not equipped with a particulate filter pressure bank 2, sensor 1 or if this sensor was used for the VREF measurement in C3, GO to [C31](#).

Note: Only measure the circuits that apply to the vehicle being diagnosed.

- Ignition OFF.
- Particulate Filter Pressure Bank 2, Sensor 1 connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C31 . |
| No | <p>INSTALL a new Particulate Filter Pressure Bank 2, Sensor 1. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls.</p> <p>Clear the PCM DTCs. REPEAT the self-test.</p> |

C31 CHECK THE REFERENCE VOLTAGE WITH THE TCIPT SENSOR CONNECTED

Note: *If the vehicle is not equipped with a TCIPT sensor or if this sensor was used for the VREF measurement in C3, GO to [C32](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.
- TCIPT Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C32 . |
| No | <p>INSTALL a new TCIPT sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls.</p> <p>Clear the PCM DTCs. REPEAT the self-test.</p> |

C32 CHECK THE REFERENCE VOLTAGE WITH THE EP SENSOR CONNECTED

Note: *If the vehicle is not equipped with an EP sensor or if this sensor was used for the VREF measurement in C3, GO to [C33](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.
- EP Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C33 . |
| No | INSTALL a new EP sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

C33 CHECK THE REFERENCE VOLTAGE WITH THE EGR VALVE CONNECTED

Note: *If the vehicle is not equipped with an EGR valve or if this valve was used for the VREF measurement in C3, GO to [C34](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.
- EEGR Assembly connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| | |
|--|--------|
| (+) Suspect Sensor Connector, Harness Side | (-) |
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C34 . |
| No | INSTALL a new EEGR assembly. Clear the PCM DTCs. REPEAT the self-test. |

C34 CHECK THE REFERENCE VOLTAGE WITH THE DIFFERENTIAL PRESSURE FEEDBACK EXHAUST GAS RECIRCULATION (DPFEGR) SENSOR CONNECTED

Note: *If the vehicle is not equipped with a DPFEGR sensor or if this sensor was used for the VREF measurement in C3, GO to [C35](#).*

Note: *Only measure the circuits that apply to the vehicle being diagnosed.*

- Ignition OFF.
- Differential Pressure Feedback EGR Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| | |
|--|--------|
| (+) Suspect Sensor Connector, Harness Side | (-) |
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | GO to C35 . |
| No | INSTALL a new DPFEGR sensor. Clear the PCM DTCs. REPEAT the self-test. |

C35 CHECK THE REFERENCE VOLTAGE WITH THE FTP SENSOR CONNECTED

- Ignition OFF.
- FTP Sensor connector connected.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) Suspect Sensor Connector, Harness Side | (-) |
|--|--------|
| VREF | Ground |

Is the voltage between 4.5 - 5.5 V?

| | |
|------------|--|
| Yes | The concern is intermittent. GO to Pinpoint Test Z . |
| No | INSTALL a new FTP sensor. REFER to the Workshop Manual Section 303-13, Evaporative Emissions. Clear the PCM DTCs. REPEAT the self-test. |

C36 CHECK THE SIGRTN OR ETCRTN CIRCUITS FOR AN OPEN

- Ignition OFF.
- Disconnect the PCM.
- For ETCRTN concerns.
- Measure the resistance between:

| (+) ETBTPS Connector, Harness Side | (-) PCM Connector, Harness Side |
|--------------------------------------|-----------------------------------|
| ETCRTN | ETCRTN |

- For APPRTN concerns.
- Measure the resistance between:

| (+) APP Sensor Connector, Harness Side | (-) PCM Connector, Harness Side |
|--|-----------------------------------|
| APPRTN1 | APPRTN1 |
| APPRTN2 | APPRTN2 |

- For SIGRTN concerns.
- Measure the resistance between:

| (+) Suspect Sensor Connector, Harness Side | (-) PCM Connector, Harness Side |
|--|-----------------------------------|
| SIGRTN | SIGRTN |

Is the resistance less than 5 ohms?

| | |
|------------|--|
| Yes | GO to C38 . |
| No | REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test. |

C37 CHECK THE SUSPECT SENSOR FOR AN INTERNAL SHORT

- Clear the KOEO, KOER, and continuous DTCs.
- Ignition OFF.
- Connect the suspect sensor.
- Ignition ON, engine OFF.
- Carry out the PCM self-test.

Is the concern still present?

| | |
|------------|---|
| Yes | INSTALL a new sensor for the sensor in question. Clear the PCM DTCs. REPEAT the self-test. |
| No | The concern is intermittent. GO to Pinpoint Test Z . |

C38 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) , Programming the VID Block for a Replacement PCM. |
| No | The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. |

Section 5: Pinpoint Tests

2018 Gasoline

Procedure revision date: 12/02/2020

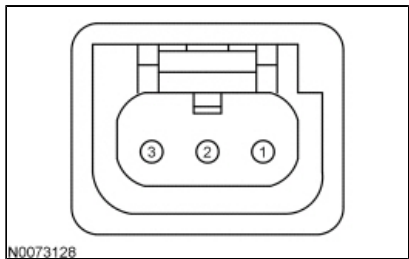
DR: Camshaft Position (CMP) Sensor

This pinpoint test is intended to diagnose the following:

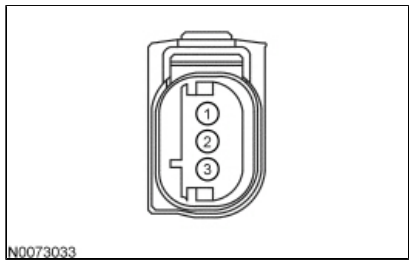
- CMP sensor (6B288 or 12K073)
- harness circuits: CMP, SIGRTN, VBPWR or VREF
- PCM (12A650)

Camshaft Position Bank 1 Sensor 1 (CMP11) Sensor Connector

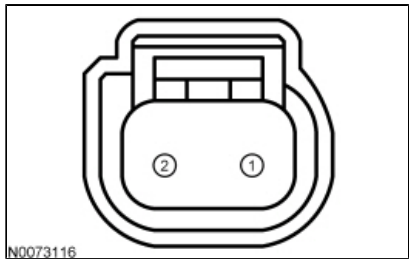
A



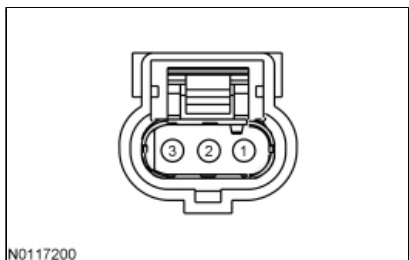
B



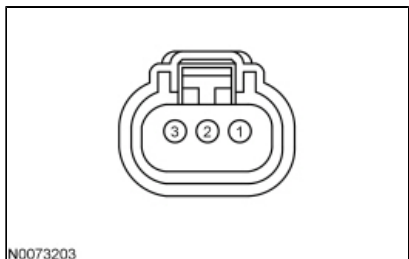
C



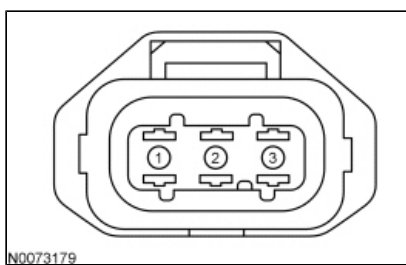
D



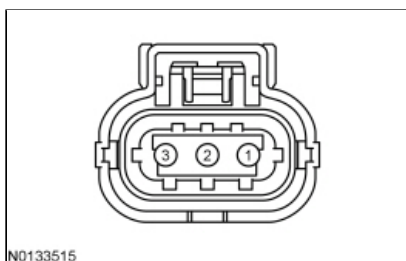
E



F



G



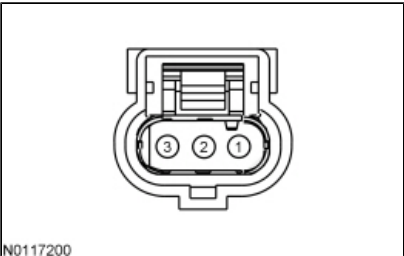
| Vehicle | Connector | Pin | Circuit |
|-------------------|-----------|-----|---------|
| Continental 2.0L, | A | 1 | VREF |
| EcoSport 2.0L, | | 2 | SIGRTN |
| Edge 2.0L, | | 3 | CMP11 |
| Escape/Kuga 2.0L, | | | |
| Explorer 2.3L, | | | |
| Focus 2.0L, | | | |
| Focus 2.3L, | | | |
| Fusion 2.0L, | | | |
| MKC, | | | |
| MKT 2.0L, | | | |
| MKX 2.0L, | | | |
| MKZ 2.0L, | | | |
| Mustang 2.3L, | | | |
| Taurus 2.0L | | | |

| Vehicle | Connector | Pin | Circuit |
|---|-----------|-------------|--------------------------|
| E-Series 6.2L, F-Series Super Duty 6.2L | B | 3 2 1 | VBPWR SIGRTN CMP11 |
| E-Series 6.8L, F-650 / F-750, F-Series Super Duty 6.8L, Flex TiVCT 3.5L, MKT 3.7L, Motorhome / Stripped Chassis / Step Van, Taurus 3.7L | C | 1 2 | SIGRTN CMP11 |
| EcoSport 1.5L, F-150 5.0L, Mustang 5.0L | D | 1 2 3 | VREF SIGRTN CMP11 |
| EcoSport 1.0L, Fiesta TiVCT 1.6L, Focus 1.0L, Ranger | D | 1 3 2 | VREF SIGRTN CMP11 |
| Escape/Kuga 2.5L, Fusion 2.5L, Transit Connect | E | 1 3 2 | VBPWR SIGRTN CMP11 |
| Escape/Kuga 1.5L, Fiesta GTDI 1.6L, Fusion 1.5L | F | 3 1 2 | VREF SIGRTN CMP11 |
| Expedition, F-150 3.3L, F-150 3.5L, F-150 2.7L, Navigator | D | 3 2 1 | VREF SIGRTN CMP11 |

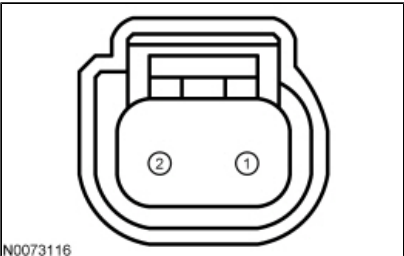
| Vehicle | Connector | Pin | Circuit |
|------------------------|-----------|-----|---------|
| Fiesta 1.0L, KA | G | 1 | VREF |
| | | 3 | SIGRTN |
| | | 2 | CMP11 |
| Mustang 5.2L | B | 1 | VPWR |
| | | 3 | SIGRTN |
| | | 2 | CMP11 |
| All other vehicles | D | 3 | VPWR |
| | | 2 | SIGRTN |
| | | 1 | CMP11 |

Camshaft Position Bank 1 Sensor 2 (CMP12) Sensor Connector

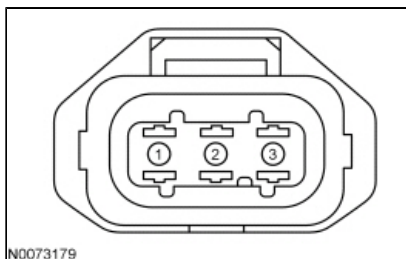
A



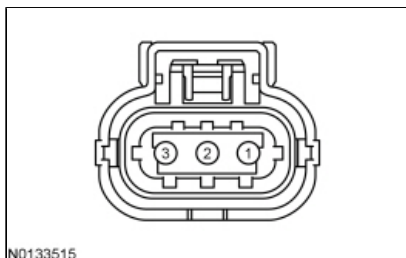
B



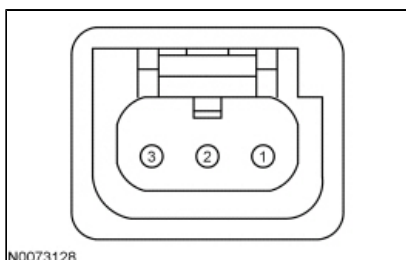
C



D



E

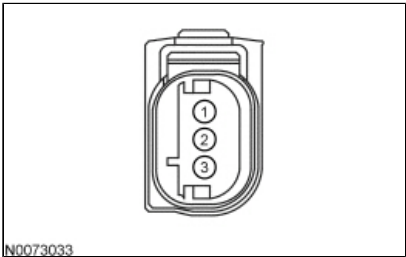


| Vehicle | Connector | Pin | Circuit |
|--|-----------|-------------|--------------------------|
| Continental 2.7L, Continental 3.0L, Edge 2.7L, Ford GT, Fusion 2.7L, MKX 2.7L, MKZ 3.0L, Transit 3.5L | A | 3 2 1 | VBPWR SIGRTN CMP12 |
| Continental 3.7L, Edge 3.5L, Explorer 3.7L, | B | 1 2 | SIGRTN CMP12 |

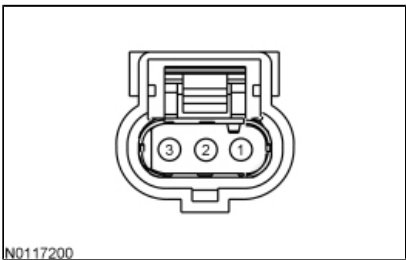
| Vehicle | Connector | Pin | Circuit |
|--|-----------|-------------|-------------------------|
| Explorer 3.5L, Flex, MKT 3.7L, MKX 3.7L, Mustang 5.2L, Taurus 3.5L, Taurus 3.7L, Transit 3.7L | | | |
| EcoSport 1.5L, F-150 5.0L, Mustang 5.0L | A | 1 2 3 | VREF SIGRTN CMP12 |
| EcoSport 1.0L, Fiesta TiVCT 1.6L, Focus 1.0L | A | 1 3 2 | VREF SIGRTN CMP12 |
| Escape/Kuga 1.5L, Fiesta GTDI 1.6L, Fusion 1.5L | C | 3 1 2 | VREF SIGRTN CMP12 |
| Expedition, F-150 2.7L, F-150 3.3L, F-150 3.5L, Navigator | A | 3 2 1 | VREF SIGRTN CMP12 |
| Fiesta 1.0L, KA | D | 1 3 2 | VREF SIGRTN CMP12 |
| All other vehicles | E | 1 2 3 | VREF SIGRTN CMP12 |

Camshaft Position Bank 2 Sensor 1 (CMP21) Sensor Connector

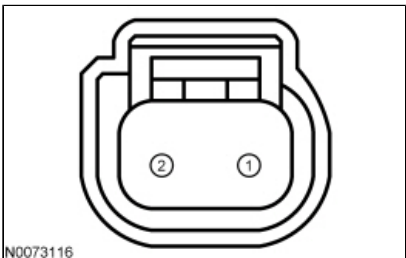
A



B



C

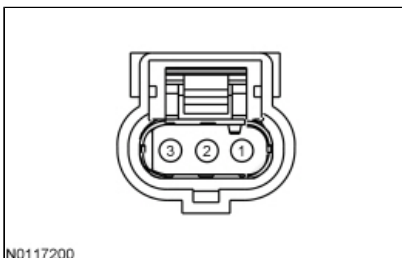


| Vehicle | Connector | Pin | Circuit |
|---|-----------|-----|---------|
| E-Series, F-Series Super Duty | A | 3 | VPWR |
| | | 2 | SIGRTN |
| | | 1 | CMP21 |
| Expedition, F-150 2.7L, F-150 3.3L, | B | 3 | VREF |
| | | 2 | SIGRTN |
| | | 1 | CMP21 |

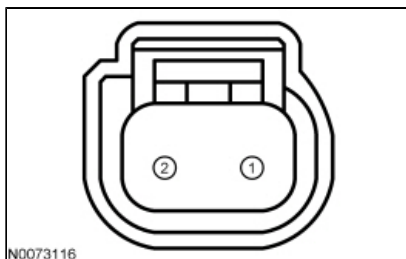
| Vehicle | Connector | Pin | Circuit |
|------------------------------|-----------|-------------|-------------------------|
| F-150 3.5L, Navigator | | | |
| F-150 5.0L | B | 1 2 3 | VREF SIGRTN CMP21 |
| Flex TiVCT 3.5L, MKT 3.7L | C | 1 2 | SIGRTN CMP21 |
| Mustang 5.0L | A | 1 2 3 | VREF SIGRTN CMP21 |
| Mustang 5.2L | A | 1 3 2 | VPWR SIGRTN CMP21 |
| All other vehicles | B | 3 2 1 | VPWR SIGRTN CMP21 |

Camshaft Position Bank 2 Sensor 2 (CMP22) Sensor Connector

A



B



| Vehicle | Connector | Pin | Circuit |
|--|-----------|-------------|--------------------------|
| Continental 2.7L, Continental 3.0L, Edge 2.7L, Ford GT, Fusion, MKX 2.7L, MKZ, Transit 3.5L | A | 3 2 1 | VBPWR SIGRTN CMP22 |
| Expedition, F-150 2.7L, F-150 3.3L, F-150 3.5L, Navigator | A | 3 2 1 | VREF SIGRTN CMP22 |
| F-150 5.0L, Mustang 5.0L | A | 1 2 3 | VREF SIGRTN CMP22 |
| All other vehicles | B | 1 2 | SIGRTN CMP22 |

Powertrain Control Module (PCM) Connector

For PCM connector views or reference values, refer to Section 6, Reference Values.

| Vehicle | Connector | Pin | Circuit |
|--|-----------|--|---|
| Continental 2.7L, Continental 3.0L | 198 PIN | E22 E54 E28 E53 | VBPWR CMP12 CMP11 SIGRTN |
| Continental 3.7L, Edge 3.5L, Explorer TiVCT 3.5L, Explorer 3.7L, Flex TiVCT 3.5L, MKT 3.7L, MKX 3.7L, Mustang 5.2L, Taurus TiVCT 3.5L, Taurus 3.7L, Transit 3.7L | 198 PIN | E17 E41 E42 E55 E56 E40, E49, E54 | VBPWR CMP22 CMP21 CMP12 CMP11 SIGRTN |
| E-Series 6.2L, F-Series Super Duty 6.2L | 198 PIN | E17 E42 E56 E49 | VBPWR CMP21 CMP11 SIGRTN |
| E-Series 6.8L, F-650 / F-750 | 198 PIN | E55 E54 | CMP11 SIGRTN |
| EcoSport 1.0L Manual Transmission, Fiesta 1.0L, Fiesta GTDI 1.6L | 198 PIN | E7 E37 E36 E20 | VREF CMP12 CMP11 SIGRTN |
| EcoSport 1.5L Automatic Transmission | 198 PIN | E28 E30 | VREF CMP12 |

| Vehicle | Connector | Pin | Circuit |
|--|-----------|-----|---------|
| | | E45 | CMP11 |
| | | E29 | SIGRTN |
| EcoSport 1.5L Manual Transmission | 112 PIN | E11 | VREF |
| | | E33 | CMP12 |
| | | E34 | CMP11 |
| | | E38 | SIGRTN |
| Edge 2.7L, Ford GT, Fusion 2.7L, MKX 2.7L, MKZ 3.0L, Transit 3.5L | 198 PIN | E22 | VBPWR |
| | | E70 | CMP22 |
| | | E26 | CMP21 |
| | | E54 | CMP12 |
| | | E28 | CMP11 |
| | | E53 | SIGRTN |
| Escape/Kuga 1.5L | 198 PIN | E11 | VREF |
| | | E22 | CMP12 |
| | | E23 | CMP11 |
| | | E29 | SIGRTN |
| Escape/Kuga 2.5L, Fusion 2.5L, Transit Connect | 198 PIN | E17 | VBPWR |
| | | E45 | CMP11 |
| | | E35 | SIGRTN |
| Expedition, F-150 3.5L, Navigator | 198 PIN | E3 | VREF |
| | | E69 | CMP22 |
| | | E26 | CMP21 |
| | | E54 | CMP12 |
| | | E40 | CMP11 |
| | | E29 | SIGRTN |
| Explorer GTDI 3.5L, Flex GTDI 3.5L, MKT 3.5L, | 198 PIN | E22 | VBPWR |
| | | E26 | CMP21 |
| | | E28 | CMP11 |

| Vehicle | Connector | Pin | Circuit |
|--|-----------|--|--|
| Taurus GTDI 3.5L | | E53 | SIGRTN |
| F-150 2.7L, F-150 3.3L, F-150 5.0L, Mustang 5.0L | 306 PIN | E118 E77 E75 E54 E76 E47, E91 | VREF CMP22 CMP21 CMP12 CMP11 SIGRTN |
| F-Series Super Duty 6.8L, Motorhome / Stripped Chassis / Step Van | 198 PIN | E46 E29 | CMP11 SIGRTN |
| Fiesta TiVCT 1.6L | 128 PIN | T13 T19 T21 T27, T29 | VREF CMP12 CMP11 SIGRTN |
| Focus GDI 2.0L | 154 PIN | E15, E16 E79 E80 E44, E47 | VREF CMP12 CMP11 SIGRTN |
| KA | 128 PIN | T28, T30 T11 T12 T21, T22 | VREF CMP12 CMP11 SIGRTN |
| Mustang 2.3L | 198 PIN | E19 E28 E27 E14 | VREF CMP12 CMP11 SIGRTN |
| Ranger | 128 PIN | T18 T21 T29 | VREF CMP11 SIGRTN |
| All other vehicles | 198 PIN | E6 | VREF |

| Vehicle | Connector | Pin | Circuit |
|---------|-----------|-----|---------|
| | | E54 | CMP12 |
| | | E28 | CMP11 |
| | | E53 | SIGRTN |

DR1 CHECK FOR DTCS

Are DTCs P0340, P0341, P0344, P0345, P0346, P0349, P0365, P0366, P0369, P0390, P0391, or P0394 present?

| | |
|------------|---|
| Yes | For vehicles with DTCs and a no crank or no start symptom, GO to DR5 . For all others, GO to DR2 . |
| No | For symptoms without DTCs, GO to DR2 . For all others, RETURN to Section 3, Symptom Charts for further direction. |

DR2 INSPECT THE HARNESS

- Ignition OFF.
- Check the harness for routing, alterations, incorrect shielding, or electrical interference from other systems.
- Check the CMP connector for damage or corrosion.

Is a concern present?

| | |
|------------|---|
| Yes | REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to DR3 . |

DR3 CLEAR AND ATTEMPT TO RETRIEVE THE DTC

Note: Consider the ignition system, alternator noise, radio frequency interference and crankshaft position (CKP) sensor concerns if DTCs P0340, P0341, P0344, P0345, P0346, P0349, P0365, P0366, P0369, P0390, P0391, or P0394 are present.

Note: For vehicles with variable camshaft timing (VCT), concerns with the engine oil level, oil filter, oil contamination, or the VCT system may cause camshaft positioning errors.

- Ignition ON, engine OFF.
- Clear the PCM DTCs.
- Ignition ON, engine running.
- Increase engine speed to greater than 1,500 RPM for 10 seconds. Repeat this 3 times.
- Carry out the PCM self-test.

Are DTCs P0340, P0341, P0344, P0345, P0346, P0349, P0365, P0366, P0369, P0390, P0391 or P0394 present?

| | |
|------------|--|
| Yes | GO to DR4 . |
| No | For symptoms without DTCs, RETURN to Section 3, Symptom Charts for further direction. For all others, GO to Pinpoint Test Z . |

DR4 CHECK THE GENERATOR FOR EXCESSIVE ELECTRICAL NOISE

Note: If the generator/regulator is electrically noisy, the noise decreases when the B+ connector is disconnected.

- Ignition ON, engine running.
- Monitor the generator for an audible electric noise.
- Ignition OFF.
- Generator/regulator B+ connector disconnected.
- Ignition ON, engine running.
- With the engine running, determine if the generator noise remains steady, decreases or increases in volume.

Does the generator noise remain steady when the B+ connector is disconnected?

| | |
|------------|---|
| Yes | GO to DR5 . |
| No | REFER to the Workshop Manual Section 414-00, Charging System, to DIAGNOSE the generator is noisy symptom. |

DR5 CHECK THE VOLTAGE TO THE CMP SENSOR

Note: Diagnose the suspect CMP sensor indicated by the DTC. For 2 pin VR type CMP sensor DTCs, GO to [DR6](#).

- Ignition OFF.
- Generator/regulator B+ connector connected.
- CMP Sensor connector disconnected.
- Ignition ON, engine OFF.
- For the VBPWR CMP sensors,
- Measure the voltage between:

| (+) CMP Sensor Connector, Harness Side | (-) |
|--|--------|
| VBPWR | Ground |

- For VREF CMP sensors,
- Measure the voltage between:

| (+) CMP Sensor Connector, Harness Side | (-) CMP Sensor Connector, Harness Side |
|--|--|
| VREF | SIGRTN |

Is the voltage greater than 10.5 V on the VBPWR circuit or is the voltage between 4.5 and 5.5 V on the VREF circuit?

| | |
|------------|--|
| Yes | GO to DR7 . |
| No | For Continental 2.0L, EcoSport, Edge 2.0L, Escape/Kuga 1.5L, Escape/Kuga 2.0L, |

| |
|---|
| Expedition, Explorer 2.3L, F-150, Fiesta, Focus, Fusion 1.5L, Fusion 2.0L, KA, MKC, MKT 2.0L, MKZ 2.0L, Mustang 2.3L, Mustang 5.0L, Navigator, Ranger, and Taurus 2.0L, GO to Pinpoint Test C . For all others, REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test. |
|---|

DR6 CHECK THE CMP SENSOR RESISTANCE

Note: Diagnose the suspect CMP sensor indicated by the DTC.

- Ignition OFF.
- CMP Sensor connector disconnected.
- Measure the resistance between:

| (+) CMP Sensor Connector, Component Side | (-) CMP Sensor Connector, Component Side |
|--|--|
| CMP | SIGRTN |

Is the resistance between 250 to 2000 ohms?

| | |
|------------|---|
| Yes | GO to DR7 . |
| No | INSTALL a new CMP sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

DR7 CHECK THE CMP SENSOR CIRCUITS FOR AN OPEN

- PCM connector disconnected.
- Measure the resistance between:

| (+) CMP Sensor Connector, Harness Side | (-) PCM Connector, Harness Side |
|--|-----------------------------------|
| CMP | CMP |
| SIGRTN | SIGRTN |

Are the resistances less than 5 ohms?

| | |
|------------|--|
| Yes | GO to DR8 . |
| No | REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test. |

DR8 CHECK THE CMP CIRCUIT FOR A SHORT

- Measure the resistance between:

| (+) CMP Sensor Connector, Harness Side | (-) CMP Sensor Connector, Harness Side |
|--|--|
| CMP | SIGRTN |

- Measure the resistance between:

| | |
|--|--------|
| (+) CMP Sensor Connector, Harness Side | (-) |
| CMP | Ground |

Are the resistances greater than 10K ohms?

| | |
|------------|---|
| Yes | GO to DR9 . |
| No | REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test. |

DR9 CHECK THE CMP CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition ON, engine OFF.
- Measure the voltage between:

| | |
|--|--------|
| (+) CMP Sensor Connector, Harness Side | (-) |
| CMP | Ground |

Is any voltage present?

| | |
|------------|---|
| Yes | REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to DR10 . |

DR10 CHECK THE CMP SENSOR OPERATION

- Ignition OFF.
- CMP Sensor connector connected.
- PCM connector connected.
- Ignition ON, engine running.
- Access the PCM and monitor the SYNC (MODE) PID.

Does the engine start and does the SYNC PID read YES?

| | |
|------------|---|
| Yes | GO to DR11 . |
| No | INSTALL a new CMP sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

DR11 CHECK FOR DTCS

- Carry out the PCM self-test.

Are any DTCs present?

| | |
|------------|---|
| Yes | INSTALL a new CMP sensor. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. 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. Clear the PCM DTCs. REPEAT the self-test. |

Section 5: Pinpoint Tests

2018 Gasoline

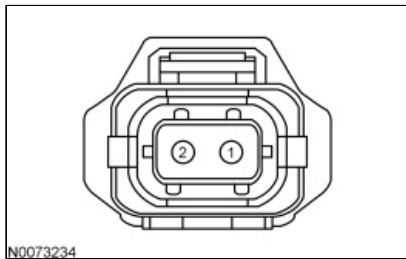
Procedure revision date: 08/27/2019

HK: Variable Camshaft Timing (VCT)

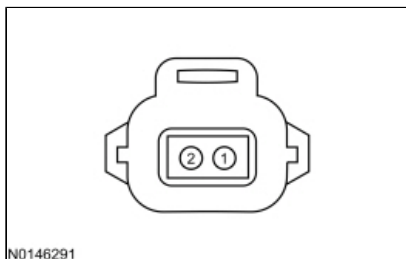
This pinpoint test is intended to diagnose the following:

- VCT solenoid (6L713) or (6B297)
- spider assembly right bank (6C260) or left bank (6C261)
- harness circuits: VPWR and VCT
- PCM (12A650)

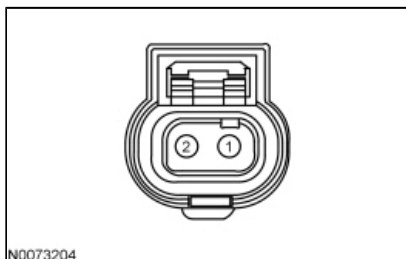
Variable Camshaft Timing Bank 1 Solenoid 1 (VCT11) Solenoid Connector



B



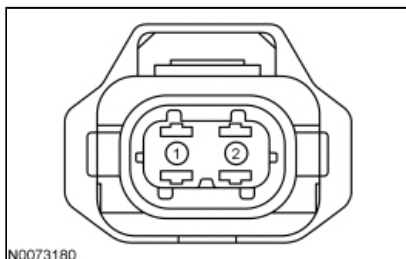
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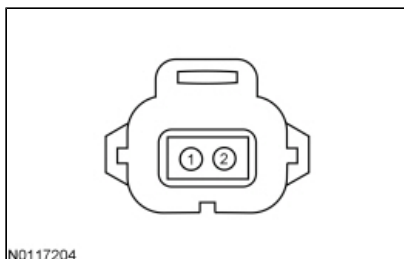
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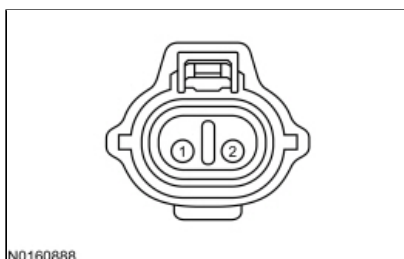
E



F



G

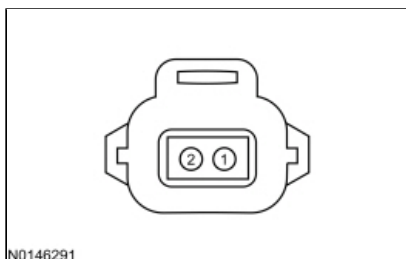


| Vehicle | Connector | Pin | Circuit |
|---|-----------|--------|---------------|
| E-Series, Expedition, F-150 5.0L, Mustang 5.0L, Navigator | A | 1 2 | VPWR VCT11 |
| EcoSport 1.5L, Escape/Kuga 1.5L, Ford GT | B | 1 2 | VPWR VCT11 |
| Escape/Kuga 2.0L, Mustang 5.2L | C | 2 1 | VPWR VCT11 |
| Explorer GTDI 3.5L, Flex GTDI 3.5L, MKT 3.5L, Taurus GTDI 3.5L | D | 1 2 | VPWR VCT11 |
| F-Series Super Duty | E | 1 | VPWR |

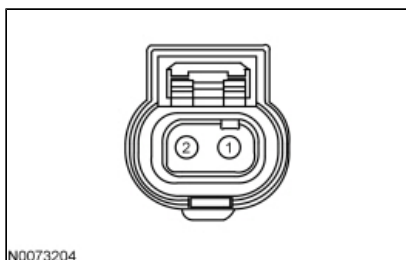
| Vehicle | Connector | Pin | Circuit |
|--------------------|-----------|-----|---------|
| | | 2 | VCT11 |
| Fiesta 1.6L, | F | 1 | VPWR |
| Fusion 1.5L | | 2 | VCT11 |
| KA 1.5L | G | 1 | VPWR |
| | | 2 | VCT11 |
| All other vehicles | C | 1 | VPWR |
| | | 2 | VCT11 |

Variable Camshaft Timing Bank 1 Solenoid 2 (VCT12) Solenoid Connector

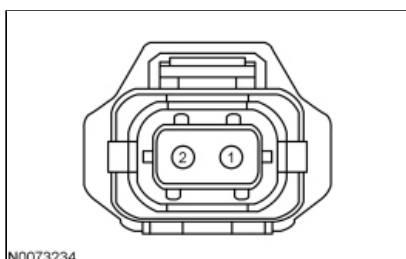
A



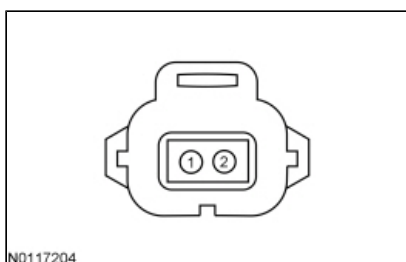
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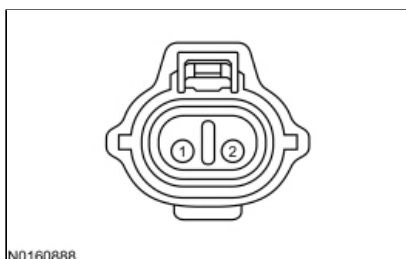
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D



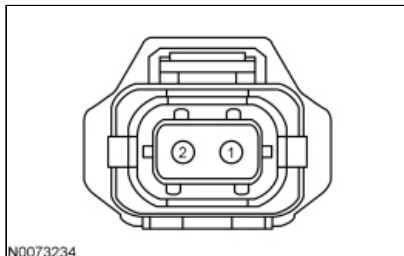
E



| Vehicle | Connector | Pin | Circuit |
|--|-----------|--------|---------------|
| EcoSport 1.5L, Escape/Kuga 1.5L, Ford GT | A | 1 2 | VPWR VCT12 |
| Escape/Kuga 2.0L, Mustang 5.2L | B | 2 1 | VPWR VCT12 |
| Expedition, F-150 5.0L, Mustang 5.0L, Navigator | C | 1 2 | VPWR VCT12 |
| Fiesta 1.6L, Fusion 1.5L | D | 1 2 | VPWR VCT12 |
| KA 1.5L | E | 1 2 | VPWR VCT12 |
| All other vehicles | B | 1 2 | VPWR VCT12 |

Variable Camshaft Timing Bank 2 Solenoid 1 (VCT21) Solenoid Connector

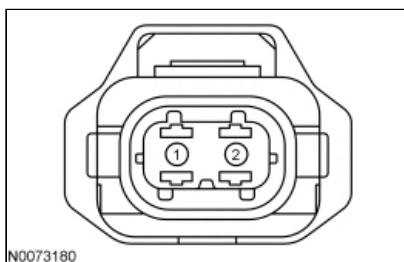
A



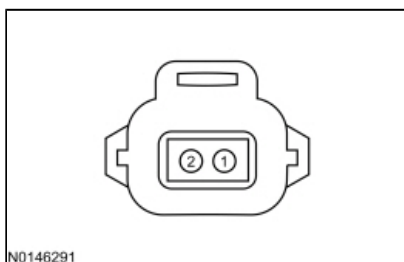
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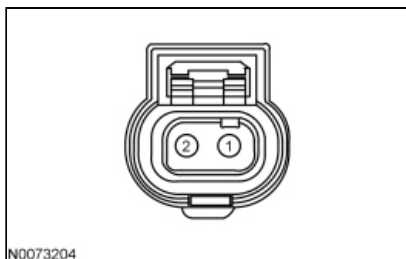
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D



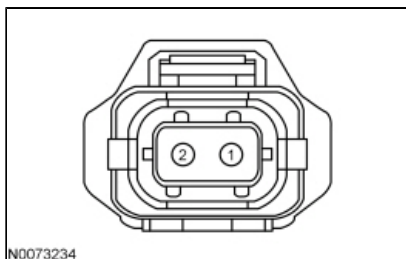
E



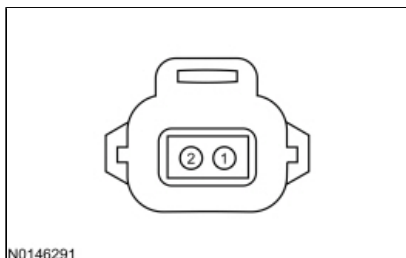
| Vehicle | Connector | Pin | Circuit |
|---|-----------|--------|---------------|
| E-Series, Expedition, F-150 5.0L, Mustang 5.0L, Navigator | A | 1 2 | VPWR VCT21 |
| Explorer GTDI 3.5L, Flex GTDI 3.5L, MKT 3.5L, Taurus GTDI 3.5L | B | 1 2 | VPWR VCT21 |
| F-Series Super Duty | C | 1 2 | VPWR VCT21 |
| Ford GT | D | 1 2 | VPWR VCT21 |
| Mustang 5.2L | E | 2 1 | VPWR VCT21 |
| All other vehicles | E | 1 2 | VPWR VCT21 |

Variable Camshaft Timing Bank 2 Solenoid 2 (VCT22) Solenoid Connector

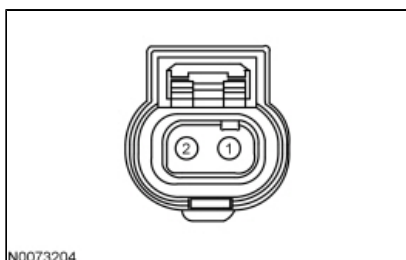
A



B



C



| Vehicle | Connector | Pin | Circuit |
|--|-----------|--------|---------------|
| Expedition, F-150 5.0L, Mustang 5.0L, Navigator | A | 1 2 | VPWR VCT22 |
| Ford GT | B | 1 2 | VPWR VCT22 |
| Mustang 5.2L | C | 2 1 | VPWR VCT22 |
| All other vehicles | C | 1 2 | VPWR VCT22 |

Powertrain Control Module (PCM) Connector

For PCM connector views or reference values, refer to Section 6, Reference Values.

| Vehicle | Connector | Pin | Circuit |
|--|-----------|---|--|
| Continental 2.7L, Continental 3.0L, Edge 2.7L, Ford GT, Transit 3.5L | 198 PIN | E17 E18 E29 E1 B101, B102, B103 | VCT22 VCT21 VCT12 VCT11 VPWR |
| Continental 3.7L, Edge 3.5L, Explorer TiVCT 3.5L, Explorer 3.7L, Flex TiVCT 3.5L, MKT 3.7L, MKX 3.7L, Mustang 5.2L, Taurus TiVCT 3.5L, Taurus 3.7L, Transit 3.7L | 198 PIN | E6 E7 E4 E5 B97, B99 | VCT22 VCT21 VCT12 VCT11 VPWR |
| E-Series 6.2L, F-Series Super Duty 6.2L | 198 PIN | E7 E5 B97, B99 | VCT21 VCT11 VPWR |
| E-Series 6.8L, F-650 / F-750, F-Series Super Duty 6.8L, Motorhome / Stripped Chassis / Step Van | 198 PIN | B97, B99 | VPWR |

| Vehicle | Connector | Pin | Circuit |
|---|-----------|--|--|
| EcoSport 1.0L Manual Transmission, Fiesta 1.0L, Fiesta GTDI 1.6L | 198 PIN | E31 E16 B101, B102, B103 | VCT12 VCT11 VPWR |
| EcoSport 1.5L Automatic Transmission | 198 PIN | E2 E1 B97, B99 | VCT12 VCT11 VPWR |
| EcoSport 1.5L Manual Transmission | 112 PIN | E45 E51 B55, B56 | VCT12 VCT11 VPWR |
| Escape/Kuga 1.5L | 198 PIN | E5 E46 B101, B102, B103 | VCT12 VCT11 VPWR |
| Escape/Kuga 2.5L, Fusion 2.5L, Transit Connect | 198 PIN | E1 B97, B99 | VCT11 VPWR |
| Expedition, F-150 3.5L, Navigator | 198 PIN | E31 E61 E16 E46 B101, B102, B103 | VCT22 VCT21 VCT12 VCT11 VPWR |
| Explorer GTDI 3.5L, Flex GTDI 3.5L, MKT 3.5L, Taurus GTDI 3.5L | 198 PIN | E18 E1 B101, B102, B103 | VCT21 VCT11 VPWR |
| F-150 2.7L, F-150 3.3L, F-150 5.0L, Mustang 5.0L | 306 PIN | E111 E25 E102 E4 | VCT22 VCT21 VCT12 VCT11 |

| Vehicle | Connector | Pin | Circuit |
|--------------------------|-----------|--------------------|---------|
| | | B1, B16, B2 | VPWR |
| Fiesta TiVCT 1.6L | 128 PIN | E42 | VCT12 |
| | | E43 | VCT11 |
| | | B11, B12, E13, E37 | VPWR |
| Focus GDI 2.0L | 154 PIN | E71 | VCT12 |
| | | E67 | VCT11 |
| | | B5, B6 | VPWR |
| Fusion 2.7L, MKZ 3.0L | 198 PIN | E17 | VCT22 |
| | | E29 | VCT21 |
| | | E18 | VCT12 |
| | | E1 | VCT11 |
| | | B101, B102, B103 | VPWR |
| KA 1.0L | 128 PIN | E46 | VCT12 |
| | | E47 | VCT11 |
| | | B36, E24 | VPWR |
| KA 1.5L | 128 PIN | E46 | VCT12 |
| | | T5 | VCT11 |
| | | B36, E24 | VPWR |
| MKX 2.7L | 198 PIN | E17 | VCT22 |
| | | E26 | VCT21 |
| | | E29 | VCT12 |
| | | E1 | VCT11 |
| | | B101, B102, B103 | VPWR |
| Mustang 2.3L | 198 PIN | E1 | VCT12 |
| | | E5 | VCT11 |
| | | B100, B101, B102 | VPWR |
| Ranger | 128 PIN | E43 | VCT11 |
| | | B11, B12 | VPWR |
| All other vehicles | 198 PIN | E29 | VCT12 |

| Vehicle | Connector | Pin | Circuit |
|---------|-----------|------------------|---------|
| | | E1 | VCT11 |
| | | B101, B102, B103 | VPWR |

HK1 CHECK FOR DTCS

Note: These DTCs may be accompanied by other DTCs. Diagnose all CMP sensor DTCs first. If no CMP sensor related DTCs are present, continue to follow diagnosis for the DTC. If any CMP DTCs are present, GO to Pinpoint Test [DR](#). If no CMP DTCs are present, continue to follow this test.

Are DTCs P000A, P000B, P0010, P0011, P0012, P0013, P0014, P0015, P0016, P0017, P0018, P0019, P0020, P0021, P0022, P0023, P0024, P0025, P052A, P052B, P052C, P052D, P054A, P054B, P054C, P054D, P2088, P2089, P2090 or P2091 present?

| | |
|------------|--|
| Yes | For DTC P0010, P0013, P0020, P0023, P2088, P2089, P2090 and P2091, GO to HK2 . For all others, GO to HK10 . |
| No | For symptoms without DTCs, GO to HK10 . For all others, RETURN to Section 3, Symptom Charts for further direction. |

HK2 CHECK FOR VCT DTCS

Note: The engine should be at operating temperature before running the self-test.

- Clear the PCM DTCs.
- Carry out the PCM self-test.

Are DTCs P0010, P0013, P0020, P0023, P2088, P2089, P2090 or P2091 present?

| | |
|------------|-----------------------------|
| Yes | GO to HK4 . |
| No | GO to HK3 . |

HK3 CARRY OUT A THOROUGH WIGGLE TEST ON THE VCT HARNESS

- Carry out a thorough wiggle test on the VCT harness.

- Carry out the PCM self-test.

Are DTCs P0010, P0013, P0020, P0023, P2088, P2089, P2090 or P2091 present?

| | |
|------------|---|
| Yes | GO to HK4 . |
| No | GO to Pinpoint Test Z . |

HK4 CHECK THE VCT SOLENOID RESISTANCE

Note: Diagnose the suspect VCT solenoid indicated by the DTC.

- Ignition OFF.
- Disconnect the VCT solenoid related to the current DTC.
- Measure the resistance between:

| (+) VCT Solenoid Connector, Component Side | (-) VCT Solenoid Connector, Component Side |
|--|--|
| VCT | VPWR |

Is the resistance between 5 - 14 ohms?

| | |
|------------|---|
| Yes | GO to HK5 . |
| No | INSTALL a new VCT solenoid. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

HK5 CHECK THE VCT SOLENOID FOR INTERNAL SHORTS

- Measure the resistance between:

| (+) VCT Solenoid Connector, Component Side | (-) |
|--|--------|
| VCT | Ground |

Is the resistance greater than 10K ohms?

| | |
|------------|---|
| Yes | GO to HK6 . |
| No | INSTALL a new VCT solenoid. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

HK6 CHECK THE VPWR CIRCUIT FOR AN OPEN

- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) VCT Solenoid Connector, Harness Side | (-) |
|--|--------|
| VPWR | Ground |

Is the voltage greater than 10.5 V?

| | |
|------------|--|
| Yes | GO to HK7 . |
| No | REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test. |

HK7 CHECK THE VCT CIRCUIT FOR AN OPEN

- Ignition OFF.
- PCM connector disconnected.
- Measure the resistance between:

| (+) VCT Solenoid Connector, Harness Side | (-) PCM Connector, Harness Side |
|--|-----------------------------------|
| VCT | VCT |

Is the resistance less than 5 ohms?

| | |
|------------|--|
| Yes | GO to HK8 . |
| No | REPAIR the open circuit. Clear the PCM DTCs. REPEAT the self-test. |

HK8 CHECK THE VCT CIRCUIT FOR A SHORT TO GROUND

- Measure the resistance between:

| (+) VCT Solenoid Connector, Harness Side | (-) |
|--|--------|
| VCT | Ground |

Is the resistance greater than 10K ohms?

| | |
|------------|---|
| Yes | GO to HK9 . |
| No | REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test. |

HK9 CHECK THE VCT CIRCUIT FOR A SHORT TO VOLTAGE

- Ignition OFF.
- Ignition ON, engine OFF.
- Measure the voltage between:

| (+) VCT Solenoid Connector, Harness Side | (-) |
|--|--------|
| VCT | Ground |

Is any voltage present?

| | |
|------------|---|
| Yes | REPAIR the short circuit. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to HK15 . |

HK10 CHECK THE OPERATION OF THE VCT SYSTEM

Note: Do not install a new component unless directed to install a new component in this pinpoint test.

Note: Some vehicles require higher RPMs and loads to actuate the VCT system than others. The VCTADVERR PID, VCT_INT_DIF PID or VCT_EXH_DIF PID should be close to zero whether actuating or not. During rapid VCT movements, the VCTADVERR PID, VCT_INT_DIF PID or VCT_EXH_DIF PID may momentarily deviate from zero.

Note: For a symptom based concern, monitor all applicable PIDs during this step.

- Ignition ON, engine OFF.
- Clear the PCM DTCs.
- Ignition ON, engine running.
- For E-Series 6.2L, Escape 2.5L, F-Series Super Duty 6.2L, Fusion 2.5L, Transit Connect:
- For DTCs P0011, P0012, P0016, P052A or P052B,
- Access the PCM and monitor the VCTADV (ANGL) and VCTADVERR (ANGL) PIDs.
- For DTCs P0018, P0021, P0022, P052C or P052D,
- Access the PCM and monitor the VCTADV2 (ANGL) and VCTADVERR2 (ANGL) PIDs.
- For all others:
- For DTCs P000A, P0011, P0012, P0016, P052A or P052B,
- Access the PCM and monitor the VCT_INT_ACT1 (ANGL) and VCT_INT_DIF1 (ANGL) PIDs.
- For DTCs P000B, P0014, P0015, P0017, P054A or P054B,
- Access the PCM and monitor the VCT_EXH_ACT1 (ANGL) and VCT_EXH_DIF1 (ANGL) PIDs.
- For DTCs P0018, P0021, P0022, P052C or P052D,
- Access the PCM and monitor the VCT_INT_ACT2 (ANGL) and VCT_INT_DIF2 (ANGL) PIDs.
- For DTCs P0019, P0024, P0025, P054C or P054D,
- Access the PCM and monitor the VCT_EXH_ACT2 (ANGL) and VCT_EXH_DIF2 (ANGL) PIDs.
- Drive the vehicle while exercising the throttle to generate VCT movement.

Does the VCTADV PID, VCT_INT_ACT PID or VCT_EXH_ACT PID indicate VCT movement while the VCTADVERR PID or VCT_INT_DIF PID or VCT_EXH_DIF PID maintain close to zero?

| | |
|------------|---|
| Yes | Unable to duplicate or identify the concern at this time. The concern may have been |
|------------|---|

| | |
|-----------|---|
| | caused by an oil flow restriction which was removed by operating the VCT system. Clear the PCM DTCs. REPEAT the self-test. |
| No | If the engine runs rough at idle and KOER or continuous memory DTCs are present, GO to HK12 . For all others, GO to HK11 . |

HK11 CHECK THE FUNCTIONALITY OF THE VCT SYSTEM

Note: Do not install a new component unless directed to install a new component in this pinpoint test.

Note: Diagnose the suspect VCT solenoid indicated by the DTC.

Note: For a symptom based concern, monitor all applicable PIDs during this step.

- For E-Series 6.2L, Escape 2.5L, F-Series Super Duty 6.2L, Fusion 2.5L, Transit Connect:
- For DTCs P0011, P0012, P0016, P052A or P052B,
- Access the PCM and monitor the VCTADV (ANGL) PID.
- For DTCs P0018, P0021, P0022, P052C or P052D,
- Access the PCM and monitor the VCTADV2 (ANGL) PID.
- For all others:
- For DTCs P000A, P0011, P0012, P0016, P052A or P052B,
- Access the PCM and monitor the VCT_INT_ACT1 (ANGL) PID.
- For DTCs P000B, P0014, P0015, P0017, P054A or P054B,
- Access the PCM and monitor the VCT_EXH_ACT1 (ANGL) PID.
- For DTCs P0018, P0021, P0022, P052C or P052D,
- Access the PCM and monitor the VCT_INT_ACT2 (ANGL) PID.
- For DTCs P0019, P0024, P0025, P054C or P054D,
- Access the PCM and monitor the VCT_EXH_ACT2 (ANGL) PID.
- Ignition OFF.
- Disconnect the VCT solenoid related to the current DTC.
- Ignition ON, engine running.
- Record the PID value at engine idle.

- Connect a 5 amp fused jumper wire between the following:

| Point A VCT Solenoid Connector, Component Side | Point B Vehicle Battery |
|--|-------------------------|
| VPWR | Positive terminal |

- Connect a 5 amp fused jumper wire between the following:

| Point A VCT Solenoid Connector, Component Side | Point B Vehicle Battery |
|--|-------------------------|
| VCT | Negative terminal |

- Record the PID value at engine idle.

Does the VCTADV PID, VCT_INT_ACT PID or VCT_EXH_ACT PID indicate VCT movement of 20 degrees or more?

| | |
|------------|--|
| Yes | The concern is not present at this time. The concern may have been caused by an oil flow restriction which was removed by operating the VCT system. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to HK12 . |

HK12 ATTEMPT TO CLEAR ANY VCT SOLENOID DEBRIS

Note: Do not install a new component unless directed to install a new component in this pinpoint test.

Note: Diagnose the suspect VCT solenoid indicated by the DTC.

Note: For a symptom based concern, monitor all applicable PIDs during this step.

- For E-Series 6.2L, Escape 2.5L, F-Series Super Duty 6.2L, Fusion 2.5L, Transit Connect:
- For DTCs P0011, P0012, P0016, P052A or P052B,
- Access the PCM and monitor the VCTADV (ANGL) PID.
- For DTCs P0018, P0021, P0022, P052C or P052D,
- Access the PCM and monitor the VCTADV2 (ANGL) PID.

- For all others:
- For DTCs P000A, P0011, P0012, P0016, P052A or P052B,
- Access the PCM and monitor the VCT_INT_ACT1 (ANGL) PID.
- For DTCs P000B, P0014, P0015, P0017, P054A or P054B,
- Access the PCM and monitor the VCT_EXH_ACT1 (ANGL) PID.
- For DTCs P0018, P0021, P0022, P052C or P052D,
- Access the PCM and monitor the VCT_INT_ACT2 (ANGL) PID.
- For DTCs P0019, P0024, P0025, P054C or P054D,
- Access the PCM and monitor the VCT_EXH_ACT2 (ANGL) PID.
- Ignition ON, engine running.
- Record the PID value at engine idle.
- Connect a 5 amp fused jumper wire between the following:

| Point A VCT Solenoid Connector, Component Side | Point B Vehicle Battery |
|--|-------------------------|
| VPWR | Positive terminal |

- Connect a 5 amp fused jumper wire between the following:

| Point A VCT Solenoid Connector, Component Side | Point B Vehicle Battery |
|--|-------------------------|
| VCT | Negative terminal |

- Quickly connect and disconnect the jumper wire to the negative battery terminal at least 20 times within 20 seconds.
- Connect the jumper wire to the negative battery terminal and leave it connected.
- Record the PID value at engine idle.

Does the VCTADV PID, VCT_INT_ACT PID or VCT_EXH_ACT PID indicate VCT movement of 20 degrees or more?

| | |
|------------|--|
| Yes | The concern is not present at this time. The concern may have been caused by an oil flow |
|------------|--|

| | |
|-----------|---|
| | restriction which was removed by operating the VCT system. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to HK13 . |

HK13 CHECK THE BASE ENGINE OIL PRESSURE

- Ignition OFF.
- Connect the VCT solenoid related to the current DTC.
- Check the base engine oil pressure. Refer to the Workshop Manual Section 303-00, Engine System, Oil Pressure Test.

Are any concerns present?

| | |
|------------|---|
| Yes | REPAIR as necessary. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to HK14 . |

HK14 CHECK THE FUNCTIONALITY OF THE VCT SOLENOID

Note: Do not install a new component unless directed to install a new component in this pinpoint test.

Note: Diagnose the suspect VCT solenoid indicated by the DTC.

- Ignition OFF.
- Disconnect the VCT solenoid related to the current DTC.
- Remove the VCT solenoid related to the current DTC. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls.
- Connect a 5 amp fused jumper wire between the following:

| Point A VCT Solenoid Connector, Component Side | Point B Vehicle Battery |
|--|-------------------------|
| VPWR | Positive terminal |

- Connect a 5 amp fused jumper wire between the following:

| Point A VCT Solenoid Connector, Component Side | Point B Vehicle Battery |
|--|-------------------------|
| VCT | Negative terminal |

- While holding the VCT solenoid, quickly connect and disconnect the jumper wire to the negative battery terminal. The VCT solenoid plunger vibration can be felt by hand when connecting the jumper wires.
- Repeat as necessary to verify the VCT solenoid operation.

Does the VCT solenoid plunger activate when the jumpers are connected?

| | |
|------------|--|
| Yes | INSTALL a new VCT phaser as necessary. REFER to the Workshop Manual Section 303-01 Engine, Timing Drive Components. Clear the PCM DTCs. REPEAT the self-test. |
| No | INSTALL a new VCT solenoid. REFER to the Workshop Manual Section 303-14, Electronic Engine Controls. Clear the PCM DTCs. REPEAT the self-test. |

HK15 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) , Programming the VID Block for a Replacement PCM. |
| No | The system is operating correctly at this time. The concern may have been caused by a loose or corroded connector. |

Z: Intermittent

This pinpoint test is intended to diagnose and isolate intermittent concerns for all electronic engine control (EEC) subsystems.

This chart is used to determine which test to run for the suspect circuit. Parameter identifiers (PIDs) corresponding to each circuit are listed. Some circuits do not have an associated PID or the PID may not be available and has to be measured with a digital multimeter (DMM). More specific information on the PID can be found in Section 6, Reference Values.

PCM PIDS/SIGNALS

| PCM/PIDS/SIGNALS | Associated Circuit | Test Type |
|------------------|--------------------|-----------|
| AAT | AAT | Input |
| APP1 | APP1 | Input |
| APP2 | APP2 | Input |
| BOO1 | BPP | Input |
| BOO2 | BPS | Input |
| Use DMM | CD A-J (primary) | Output |
| CAC_T | CACT | Input |
| CAC_V | CACT | Input |
| CACCT | CACCTS | Input |
| CACCT_V | CACCTS | Input |
| CHT | CHT | Input |
| CKP | CKP | Input |
| CMP | CMP | Input |
| CPP/PNP | CPP | Input |
| DPFE | DPFE | Input |
| EBP | EP | Input |
| ECT1, ECTS | ECT | Input |
| EGRMC1 | EGRMC1 | Output |

| PCM/PIDS/SIGNALS | Associated Circuit | Test Type |
|------------------|--------------------|-----------|
| EGRMC2 | EGRMC2 | Output |
| EGRMC3 | EGRMC3 | Output |
| EGRMC4 | EGRMC4 | Output |
| EGRMDSD | EGRMC | Output |
| EGRT12 | EGRT12 | Input |
| EGRVR | EGRVR | Output |
| EGT11 | EGT11 | Input |
| EGT21 | EGT21 | Input |
| EVAPCV | CANV | Output |
| FANDC | VDF | Output |
| FANSS | FANSS | Input |
| FANVAR | FCV | Input |
| FLI | FLI | Input |
| FLP | FLP | Input |
| FP | FP | Output |
| FP M | FPM | Input |
| FRP | FRP | Input |
| FRT | FRT | Input |
| FTP | FTP | Input |
| HFC | HFC | Output |
| IAT, IATS | IAT | Input |
| IAT12, IAT2 | IAT2 | Input |
| IMRC | IMRC | Output |
| IMRC1M | IMRC1 | Input |
| IMRC2M | IMRC2 | Input |
| IMTV | IMTV1 | Output |
| KNOCK_1 | KS11, KS12 | Input |
| KNOCK_2 | KS12, KS22 | Input |
| LFC | LFC | Output |
| MAF, MAF V | MAF | Input |
| MAP V | MAP | Input |
| MFC | MFC | Output |
| O2S12 | HO2S12 | Input |
| O2S22 | HO2S22 | Input |

| PCM/PIDS/SIGNALS | Associated Circuit | Test Type |
|-----------------------|--------------------|-----------|
| OSS | OSS | Input |
| PFP11 | PFP11 | Input |
| PFP21 | PFP21 | Input |
| PTO | PTO | Input |
| SCIP, SCIP V | TCIP | Input |
| TACM (+) | TACM (+) | Output |
| TACM (-) | TACM (-) | Output |
| TCBP | TCBP | Input |
| TCBP_V | TCBP | Input |
| TP | TP | Input |
| TP1 | TP1 | Input |
| TP2 | TP2 | Input |
| TURBO_BP1_STAT | TCBY | Output |
| TURBO_BP2_STAT | TCBY2 | Output |
| TURBO_WGATE | TCWRVS | Output |
| TWGATE_STAT | TCWRVS | Output |
| VCTADV, VCT_INT_ACT1 | VCT11 | Input |
| VCTADV2, VCT_INT_ACT2 | VCT21 | Input |
| VCT_EXH_ACT1 | VCT12 | Input |
| VCT_EXH_ACT2 | VCT22 | Input |
| VPWR | VPWR | Input |
| Use DMM | VREF | Output |
| Use DMM | VSO | Output |
| VSS | VSS+ | Input |
| WGATE_PRES | WVS | Input |
| WGATE_V | WVS | Input |

Z1 DIRECTION FOR INTERMITTENT DIAGNOSTIC PATH

Note: Proceed with this step only if the PCM DTCs and the freeze frame data have not been cleared. Record freeze frame data prior to clearing the PCM DTCs. Clearing the DTCs clears any freeze frame data and eliminates FMEM. This helps to recreate the original conditions that set the DTCs or caused the symptom.

- Ignition ON, engine OFF.
- Clear the PCM DTCs.

Are the PCM DTCs cleared?

| | |
|-----|--|
| Yes | GO to Z2 . |
| No | RESET the keep alive memory (KAM). REFER to Section 2, Resetting The Keep Alive Memory (KAM) . REPEAT the self-test. |

Z2 SELECT THE PIDS AND/OR SIGNALS RELATED TO THE SYSTEM

- A list of related PIDs and/or signals are needed for use with the scan tool to monitor the suspect areas. Obtain the customer symptom description. Use the Reference Value Symptom chart and proceed to the Reference Value PID/Signal Measurement chart located at the beginning of Section 6, Reference Values.
- Highlight each available PID/signal recommended by the charts under the PID/signal selection menu on the scan tool.

Are all available PIDs/signals related to the symptom selected?

| | |
|-----|--|
| Yes | GO to Z3 . |
| No | REPEAT the test step. GO to Z2 . |

Z3 DECISION TO VERIFY THE SYMPTOM

Note: *The path to symptom verification is optional but is recommended for several reasons. For example, the vehicle is back for a repeat repair, or there is no DTC present.*

Is a concern or symptom present?

| | |
|-----|-----------------------------|
| Yes | GO to Z10 . |
| No | GO to Z4 . |

Z4 COLLECT ANY SYMPTOM RELATED DATA TO AID IN VERIFICATION

Note: *Only MIL codes trigger freeze frame data. Refer to the scan tool instruction manual to retrieve the*

freeze frame information.

- Prepare the freeze frame data for use with information from the Section 3, Symptom Charts.
- Check for continuous memory DTCs that should have been recorded from an earlier pinpoint test.
- Access the information from the customer information worksheet and the customer if available. Access any other symptom related data available, such as TSBs and OASIS reports.

Is all available data recorded?

| | |
|------------|--|
| Yes | GO to Z5 . |
| No | GATHER as much data as possible to aid in isolating the intermittent concern area. REPEAT the test step. GO to Z4 . |

Z5 RECREATE THE SYMPTOM USING ALL AVAILABLE DATA

Note: *To recreate the original conditions that set the DTC or caused the symptom, the vehicle may require driving.*

- With the scan tool, select and monitor the same PIDs as displayed in freeze frame along with any previously selected PIDs/signals from step Z2. Using the freeze frame data recorded earlier, recreate the conditions described by each freeze frame PID. Pay special attention to ECT, LOAD, RPM and VSS. Also, use any available data from the customer, TSBs, and other sources to aid in producing the correct conditions for recreating the symptom.
- When the symptom occurs, press the trigger to begin recording. Refer to the scan tool instruction manual for information on the recorder function.

Can the symptom be recreated?

| | |
|------------|-----------------------------|
| Yes | GO to Z10 . |
| No | GO to Z6 . |

Z6 RECREATE THE SYMPTOM

Note: *PIDs for output in the Reference Value Charts represent command values only. Circuit measurements with a DMM indicate the actual output status. Therefore, in the case of a concern, the PID and circuit reading on the vehicle may not correspond with each other. PIDs for PCM circuits with a mismatch in the DMM measurement indicate a possible PCM concern.*

- The road test is the last attempt to locate the area of concern before physically disturbing vehicle

circuits.

- The Intermittent Road Test Procedure is a set of instructions for monitoring PIDs/signals with a scan tool and circuit measurements with a DMM. This is done under 4 different conditions - ignition on and engine off, hot idle, 48 km/h (30 mph) and 88 km/h (55 mph). Use the typical diagnostic reference values from Section 6, Reference Values to compare with the actual vehicle.
- Locate the correct reference value chart in Section 6, Reference Values.
- Setup the vehicle to measure the circuits with a DMM and a scan tool.
- Connect a scan tool to the DLC.
- Ignition ON, engine OFF.
- With the scan tool, select and monitor PIDs and measure the circuits shown in the reference value chart in Section 6, Reference Values.
- Compare the scan tool PIDs and DMM values to the reference value charts.

Are any values out of range?

| | |
|-----|-----------------------------|
| Yes | GO to Z10 . |
| No | GO to Z7 . |

Z7 RECREATE THE SYMPTOM USING THE HOT IDLE ROAD TEST

Note: *The engine temperature should be at least 87°C (189°F).*

- Ignition ON, engine running.
- Continue to monitor the PIDs and circuits as in the previous step.

Are any values out of range?

| | |
|-----|-----------------------------|
| Yes | GO to Z10 . |
| No | GO to Z8 . |

Z8 RECREATE THE SYMPTOM DURING AN 48 KM/H (30 MPH) ROAD TEST

- Drive the vehicle on a preplanned route.
- Continue to monitor the PIDs and circuits as in the previous step.

Are any values out of range?

| | |
|------------|-----------------------------|
| Yes | GO to Z10 . |
| No | GO to Z9 . |

Z9 RECREATE THE SYMPTOM DURING AN 88 KM/H (55 MPH) ROAD TEST

- Continue to drive the vehicle on the preplanned route.
- Continue to monitor the PIDs and circuits as in the previous step.

Are any values out of range?

| | |
|------------|--|
| Yes | GO to Z10 . |
| No | It is now necessary to physically disturb the selected vehicle circuits in an attempt to recreate the intermittent concern. GO to Z10 . |

Z10 SELECT THE CIRCUITS FROM THE PCM PIDS/SIGNALS CHART

Note: *From the same chart, be sure to select and proceed with the appropriate test type.*

Note: *The Input Test step should be used on sensing inputs such as temperature, position or oxygen.*

Note: *The Output Test step should be used on output devices such as relays, coils or solenoids.*

- Remain in the PID/Signal selection menu with the scan tool.
- Highlight only the PIDs/signals from step Z2.
- Proceed to the PCM PIDS/SIGNALS chart located at the beginning of this test.
- Match the selected PIDs/signals to the corresponding circuit in the chart. There may be more than one circuit to test. If a PID/signal recording was made with the scan tool, it may be helpful to replay it at this time. Refer to the scan tool instruction manual for additional information.

Has a test been chosen?

| | |
|------------|---|
| Yes | For the input test step, GO to Z11 . For the output test step, GO to Z15 . |
| No | RETURN to Section 3, Symptom Charts for further direction. |

Z11 KOEO INPUT TEST PROCEDURE FOR THE PCM SENSORS

WARNING: When carrying out any test steps, always be aware of hands, clothing or tools near cooling fans, belts or hot surfaces. Failure to follow these instructions may result in personal injury.

- Using the circuits chosen from the Section 6, PCM PIDS/SIGNALS Chart, select only the recommended PIDs/signals to monitor with the scan tool. If a PID is not available for the circuit, use a DMM to check the value.
- Proceed to the area of the suspect wiring or component concern.
- Ignition ON, engine OFF.
- If the input is a switch type-component, turn it on manually.
- Monitor the PID or DMM and wiggle the sensor harness wire from the component to the PCM.
- Look for abrupt changes in the values. Compare these actual values to the reference values in Section 6, Reference Values.

Are there abrupt changes in the PID values that do not compare with the Section 6, typical reference values?

| | |
|------------|--|
| Yes | REPAIR as necessary. VERIFY the repair. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to Z12 . |

Z12 KOER INPUT TEST PROCEDURE FOR THE PCM SENSORS

WARNING: When carrying out any test steps, always be aware of hands, clothing or tools near cooling fans, belts or hot surfaces. Failure to follow these instructions may result in personal injury.

- Ignition ON, engine running.
- Continue to monitor the PIDs and circuits as in the previous step.
- Proceed to the area of the suspect wiring or component concern.
- If the input is a switch type-component, turn it on manually.
- Monitor the PID or DMM and wiggle the sensor harness wire from the component to the PCM.
- Look for abrupt changes in the values. Compare these actual values to the reference values in Section 6, Reference Values.

Are any values fluctuating in and out of range?

| | |
|------------|--|
| Yes | REPAIR as necessary. VERIFY the repair. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to Z13 . |

Z13 KOEO WATER SOAK TEST PROCEDURE FOR THE PCM SENSORS, EXCLUDING HIGH VOLTAGE CIRCUITS

WARNING: When carrying out any test steps, always be aware of hands, clothing or tools near cooling fans, belts or hot surfaces. Failure to follow these instructions may result in personal injury.

- Ignition ON, engine OFF.
- Continue to monitor the PIDs and circuits as in the previous step.
- Proceed to the area of the suspect wiring or component concern.
- If the input is a switch type-component, turn it on manually.
- Monitor the PID or DMM values while lightly spraying a water mist on the component.
- Monitor while spraying the sensor harness wire from the component to the PCM.
- Look for abrupt changes in the values. Compare these actual values to the Typical Diagnostic Reference Values in Section 6.

Are any values fluctuating in and out of range?

| | |
|------------|--|
| Yes | REPAIR as necessary. VERIFY the repair. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to Z14 . |

Z14 KOER WATER SOAK TEST PROCEDURE FOR THE PCM SENSORS, EXCLUDING HIGH VOLTAGE CIRCUITS

WARNING: When carrying out any test steps, always be aware of hands, clothing or tools near cooling fans, belts or hot surfaces.

Failure to follow these instructions may result in personal injury.

- Ignition ON, engine running.

- Continue to monitor the PIDs and circuits as in the previous step.
- Proceed to the area of the suspect wiring or component concern.
- If the input is a switch type-component, turn it on manually.
- Monitor the PID or DMM values while lightly spraying a water mist on the component.
- Monitor while spraying the sensor harness wire from the component to the PCM.
- Look for abrupt changes in the values. Compare these actual values to the Typical Diagnostic Reference Values in Section 6.

Are any values fluctuating in and out of range?

| | |
|------------|--|
| Yes | REPAIR as necessary. VERIFY the repair. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to Z15 . |

Z15 KOER WIGGLE TEST PROCEDURE FOR THE PCM SENSORS

WARNING: When carrying out any test steps, always be aware of hands, clothing or tools near cooling fans, belts or hot surfaces. Failure to follow these instructions may result in personal injury.

Note: Remember that PIDs selected from the PCM PIDS/SIGNALS Chart display commanded values only. A DMM measurement is needed to display the actual values. Be sure to compare them. Look for fluctuations to occur during any part of the following test. The output state test may not control some outputs, such as injectors and ignition coils and may not be available for all actuators.

- Using the circuits chosen from the PCM PIDS/SIGNALS Chart, select only the recommended PIDs/signals to monitor with the scan tool. If a PID is not available for the circuit, use a DMM to check the value.
- Ignition ON, engine OFF.
- With the scan tool, turn on selected outputs using output state control. Refer to the scan tool instruction manual.
- Proceed to the area of the suspect wiring or component concern.
- Monitor the PID or DMM and wiggle the sensor harness wire from the component to the PCM.
- Look for abrupt changes in the values. Compare these actual values to the reference values in Section 6, Reference Values.

Is there a mismatch between command and actual or are any values fluctuating in and out of range

when compared to the reference value charts in Section 6, Reference Values?

| | |
|-----|--|
| Yes | REPAIR as necessary. VERIFY the repair. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to Z16 . |

Z16 KOER OUTPUT TEST PROCEDURE FOR THE PCM ACTUATORS

WARNING: When carrying out any test steps, always be aware of hands, clothing or tools near cooling fans, belts or hot surfaces. Failure to follow these instructions may result in personal injury.

Note: Remember that PIDs selected from the PCM PIDS/SIGNALS Chart display commanded values only. A DMM measurement is needed to display the actual values. Be sure to compare them. Look for fluctuations to occur during any part of the following test. The output state test may not control some outputs, such as injectors and ignition coils and may not be available for all actuators.

- Ignition ON, engine running.
- Proceed to the area of the suspect wiring or component concern.
- Monitor the PIDs with the scan tool and note the values. Compare the scan tool values with values from a DMM with the engine at idle.
- If a coil for a coil on plug application is suspect, turn off the ignition. Gain access to the coil and measure continuity from the spark plug terminal to the signal terminal while tapping the coil. A large fluctuation in resistance indicates an intermittent open or short.
- Monitor the PID and wiggle the sensor harness wire from the component to the PCM.
- Look for abrupt changes in the values. Compare these actual values to the reference values in Section 6, Reference Values.

Is there a scan tool to DMM value mismatch or an idle fluctuation?

| | |
|-----|--|
| Yes | REPAIR as necessary. VERIFY the repair. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to Z17 . |

Z17 KOEO WATER SOAK TEST PROCEDURE FOR THE PCM ACTUATORS, EXCLUDING HIGH VOLTAGE CIRCUITS

WARNING: When carrying out any test steps, always be aware of hands, clothing or tools near

cooling fans, belts or hot surfaces. Failure to follow these instructions may result in personal injury.

Note: Remember that PIDs selected from the PCM PIDS/SIGNALS Chart display commanded values only. A DMM measurement is needed to display the actual values. Be sure to compare them. Look for fluctuations to occur during any part of the following test. The output state test may not control some outputs, such as injectors and ignition coils and may not be available for all actuators.

- Ignition ON, engine OFF.
- With the scan tool, turn on selected outputs using output state control. Refer to the scan tool instruction manual.
- Proceed to the area of the suspect wiring or component concern.
- Monitor the PID or DMM values while lightly spraying a water mist on the component.
- Look for abrupt changes in the values. Compare these actual values to the reference values in Section 6, Reference Values.

Is there a mismatch between command and actual or are any values fluctuating in and out of range when compared to the reference value charts in Section 6, Reference Values?

| | |
|------------|--|
| Yes | REPAIR as necessary. VERIFY the repair. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to Z18 . |

Z18 KOER WATER SOAK TEST PROCEDURE FOR THE PCM ACTUATORS

WARNING: When carrying out any test steps, always be aware of hands, clothing or tools near cooling fans, belts or hot surfaces.

Failure to follow these instructions may result in personal injury.

- Ignition ON, engine running.
- Using the circuits chosen from the PCM PIDS/SIGNALS Chart, select only the recommended PIDs/signals to monitor with the scan tool. If a PID is not available for the circuit, use a DMM to check the value.
- Proceed to the area of the suspect wiring or component concern.
- Monitor the PID or DMM values while lightly spraying a water mist on the component.
- Monitor while spraying the sensor harness wire from the component to the PCM/TCM.
- Look for abrupt changes in the values. Compare these actual values to the Typical Diagnostic

Reference Values in Section 6.

Is there a mismatch between command and actual or are any values fluctuating in and out of range when compared to the Reference Value Charts in Section 6?

| | |
|------------|--|
| Yes | REPAIR as necessary. VERIFY the repair. Clear the PCM DTCs. REPEAT the self-test. |
| No | GO to Z19 . |

Z19 INSPECT FOR INTERMITTENT MECHANICAL CONCERNS

Note: *It is possible for an intermittent mechanical concern to cause a good PCM system to react abnormally.*

- An inspection of DTC related mechanical systems should have been carried out in an earlier section. If not, visually inspect at this time.
- Look for possible vacuum lines, wires, cables, linkage or hoses that may become kinked, shorted or restricted during normal engine operation.
- This may include engine/transmission gear changes, acceleration and deceleration, rough roads and various engine RPM and torque related conditions.

Is a mechanical concern detected?

| | |
|------------|--|
| Yes | REPAIR as necessary. VERIFY the repair. Clear the PCM DTCs. REPEAT the self-test. |
| No | It is necessary to seek additional help. REFER to the Service Repair And Technical Assistance Process. A vehicle data recorder (VDR) or similar recorder may also be useful. |