

E - THEORY/OPERATION

1998 Toyota Supra

1998 ENGINE PERFORMANCE
Toyota - Theory & Operation

Avalon, Camry, Celica, Corolla, Land Cruiser, LX470, RAV4,
Sienna, Supra, Tacoma, Tercel, T100, 4Runner

INTRODUCTION

NOTE: References to California models apply to California emission vehicles, which may be verified by underhood Emission Control label. California emissions may be available in other states.

This article covers basic description and operation of engine performance-related systems and components. Read this article before diagnosing vehicles or systems with which you are not completely familiar.

AIR INDUCTION SYSTEM

ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS)

NOTE: The ETCS may also be referred to as the Electronic Throttle Control System-Intelligent (ETCS-I or ETCS-i).

Land Cruiser & LX470

The ETCS consists of throttle body, accelerator pedal position sensor, Throttle Position (TP) sensor, throttle control motor, magnetic clutch and Engine Control Module (ECM). ETCS uses the ECM to calculate throttle valve opening in the throttle body in relation to driving conditions. ETCS controls idle speed control system and cruise control system operation. Accelerator pedal position sensor is mounted on the throttle body and is integrated with throttle lever which attaches to the throttle cable. See Figs. 1-2. Accelerator pedal position sensor converts amount of accelerator pedal position into 2 different types of output signals and delivers input signals to the ECM. The TP sensor delivers input signals to ECM to indicated throttle valve opening.

The ECM uses these input signals to operate throttle control motor to obtain proper operating speeds in relation to accelerator pedal position and engine speed, obtain proper idle speed, and provide cruise control operation. Throttle control motor is mounted on side of throttle body and operates throttle valve on throttle body by use of a magnetic clutch.

In the event of a ETCS malfunction, Malfunction Indicator Light (MIL) on instrument panel will be illuminated and Diagnostic Trouble Code (DTC) will be stored in the ECM. If malfunction exists, magnetic clutch will be disengaged, allowing spring pressure to close the throttle valve. When magnetic clutch is disengaged, throttle control motor will not operate the throttle valve. If ETCS is shut off, accelerator pedal may be used to operate throttle valve for vehicle operation in limp mode by using limp mode lever on throttle body to operate the throttle valve. See Figs. 1-2.

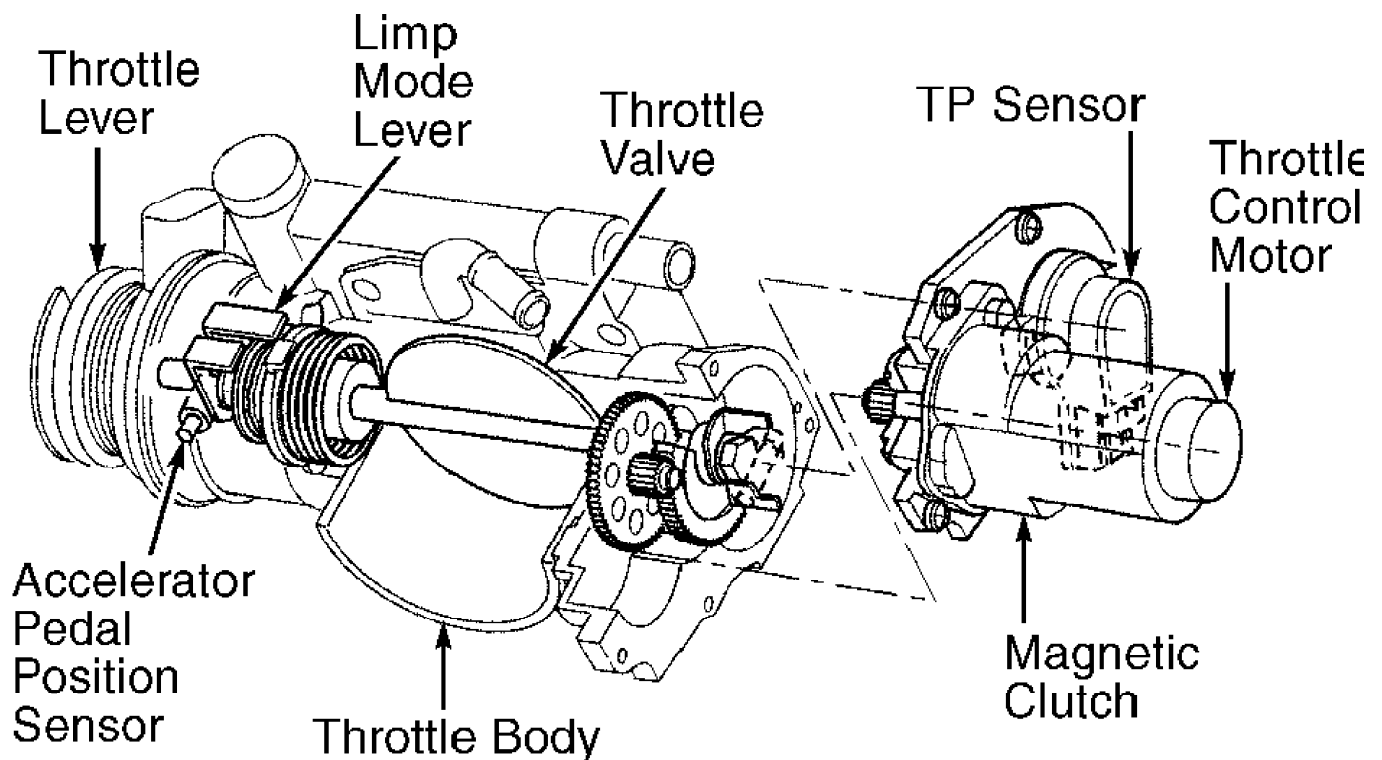
Supra Non-Turbo

The ETCS consists of throttle body, accelerator pedal position sensor, Throttle Position (TP) sensor, throttle control motor, magnetic clutch and Engine Control Module (ECM). ETCS uses the ECM to calculate throttle valve opening in the throttle body in

relation to driving conditions. ETCS controls idle speed control system and cruise control system operation. Accelerator pedal position sensor is mounted on the throttle body and is integrated with throttle lever which attaches to the throttle cable. See Figs. 1-2. Accelerator pedal position sensor converts amount of accelerator pedal effort into 2 different types of output signals and delivers input signals to the ECM. The TP sensor delivers input signals to ECM to indicated throttle valve opening.

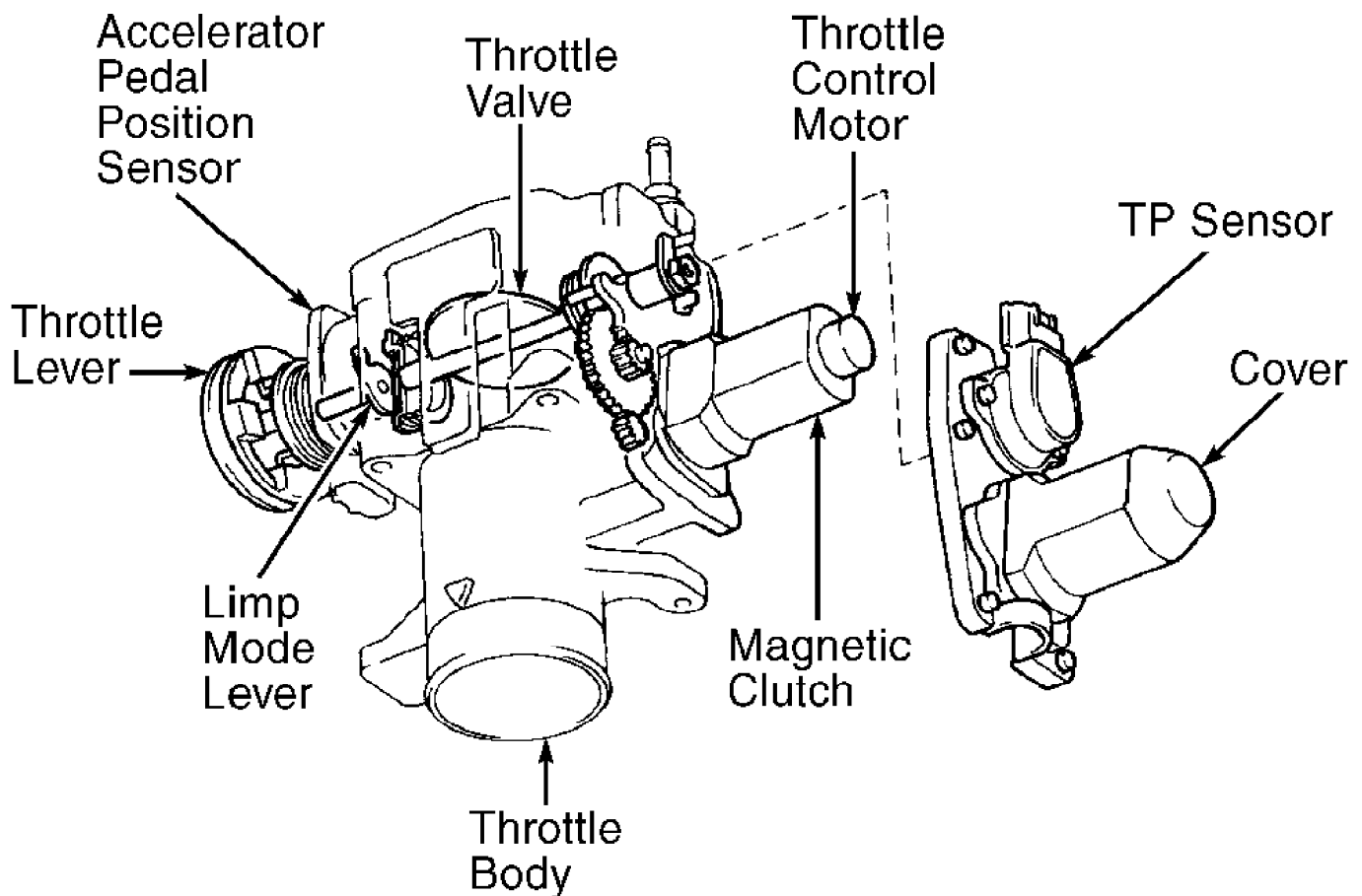
The ECM uses these input signals to operate the throttle control motor to obtain proper operating speeds in relation to accelerator pedal effort and engine speed, obtain proper idle speed and provide cruise control operation. Throttle control motor operation is also synchronized to the electronic controlled transmission during transmission shifting to reduce shift shock during transmission shifts. The throttle control motor is mounted on side of throttle body and operates the throttle valve on the throttle body by the use of a magnetic clutch.

In the event of a ETCS malfunction, Malfunction Indicator Light (MIL) on instrument panel will be illuminated and Diagnostic Trouble Code (DTC) will be stored in the ECM. If malfunction exists, magnetic clutch will be disengaged, allowing spring pressure to close the throttle valve. When magnetic clutch is disengaged, throttle control motor will not operate the throttle valve. If ETCS is shut off, accelerator pedal may be used to operate throttle valve for vehicle operation in limp mode by using limp mode lever on the throttle body to operate the throttle valve. See Figs. 1-2.



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Fig. 1: ETCS Throttle Body Components Location (Land Cruiser & LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



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Fig. 2: ETCS Throttle Body Components Location (Supra Non-Turbo)
 Courtesy of Toyota Motor Sales, U.S.A., Inc.

INTAKE AIR CONTROL VALVE SYSTEM

NOTE: Intake air control valve system may also be referred to as Acoustic Control Induction System (ACIS).

NOTE: Supra Turbo uses an intake air control valve, located on the turbocharger. For information on intake air control valve operation, see TURBOCHARGERS under AIR INDUCTION SYSTEM.

Avalon, Camry 3.0L V6 & Sienna

Engine Control Module (ECM) controls amount of airflow into intake manifold by use of an intake air control valve. Intake air control valve is located at end of air intake chamber. See Figs. 3-4. Operation of intake air control valve system provides increased power in all speed ranges. The ECM uses an engine RPM input signal and throttle position sensor input signal for determining intake air control valve system operation. Engine RPM input signal is provided by camshaft and crankshaft position sensors.

The ECM controls ground circuit for intake air control valve system Vacuum Switching Valve (VSV). The VSV controls vacuum supply from vacuum tank to the actuator, which operates intake air control valve in air intake chamber.

Supra Non-Turbo

Engine Control Module (ECM) controls amount of airflow into

intake manifold by use of an intake air control valve. Intake air control valve is located at center of air intake chamber. See Figs. 3-4. Operation of intake air control valve system provides increased power in all speed ranges.

The ECM uses various input signals for determining intake air control valve system operation. The ECM controls ground circuit for intake air control valve system Vacuum Switch Valve (VSV). The VSV controls vacuum supply from vacuum tank to the actuator which operates intake air control valve in air intake chamber.

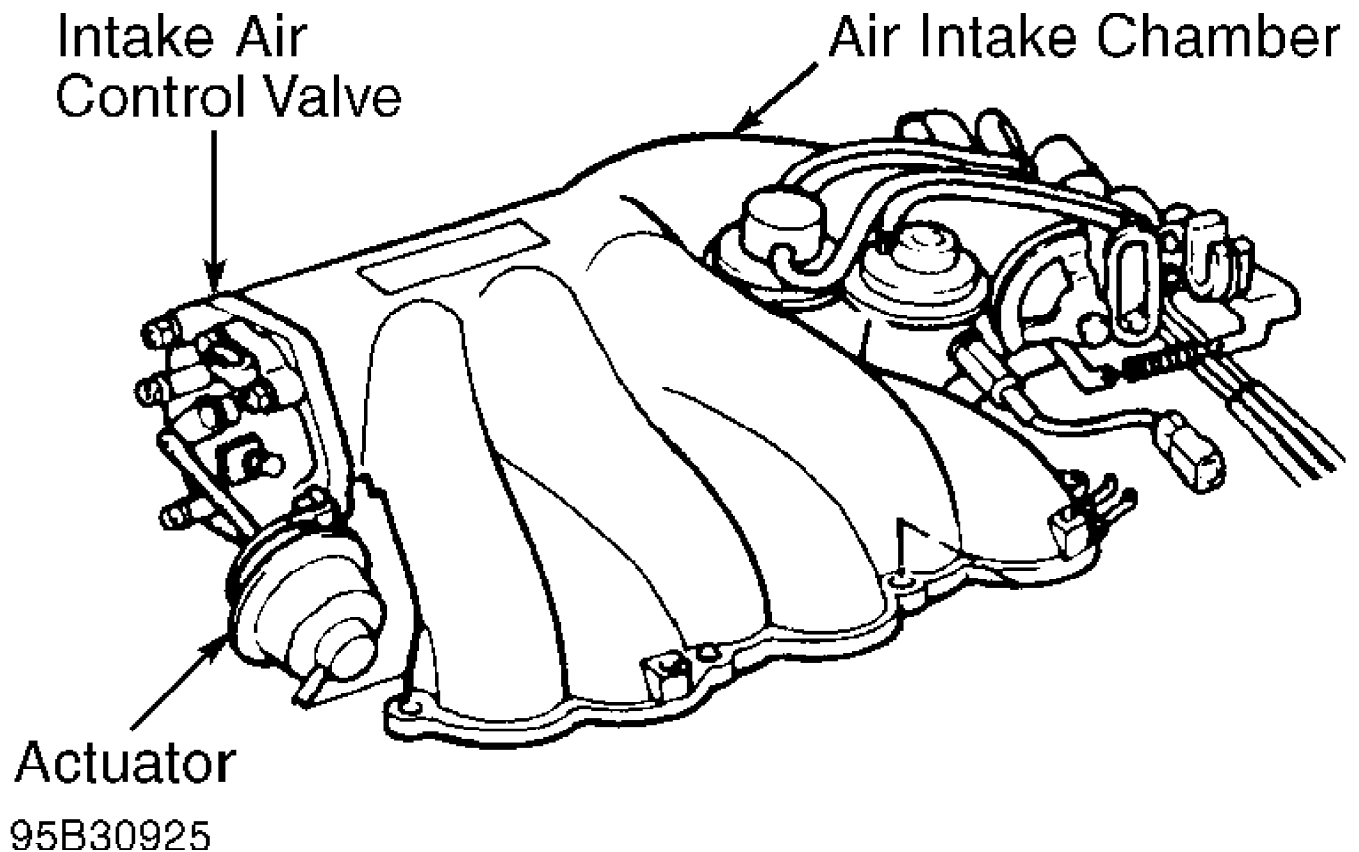


Fig. 3: Locating Intake Air Control Valve (Avalon, Camry 3.0L V6, Sienna & Supra Non-Turbo) Avalon, Camry 3.0L V6 & Sienna
Courtesy of Toyota Motor Sales, U.S.A., Inc.

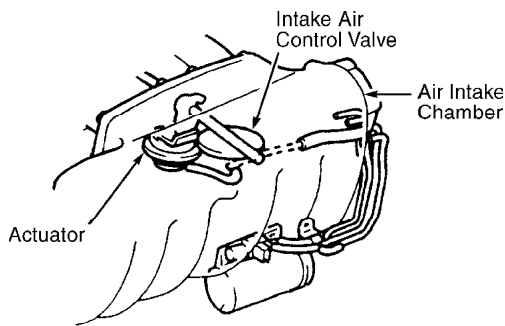


Fig. 4: Locating Intake Air Control Valve (Avalon, Camry 3.0L V6, Sienna & Supra Non-Turbo) Supra Non-Turbo
Courtesy of Toyota Motor Sales, U.S.A., Inc.

TURBOCHARGERS

Supra Turbo

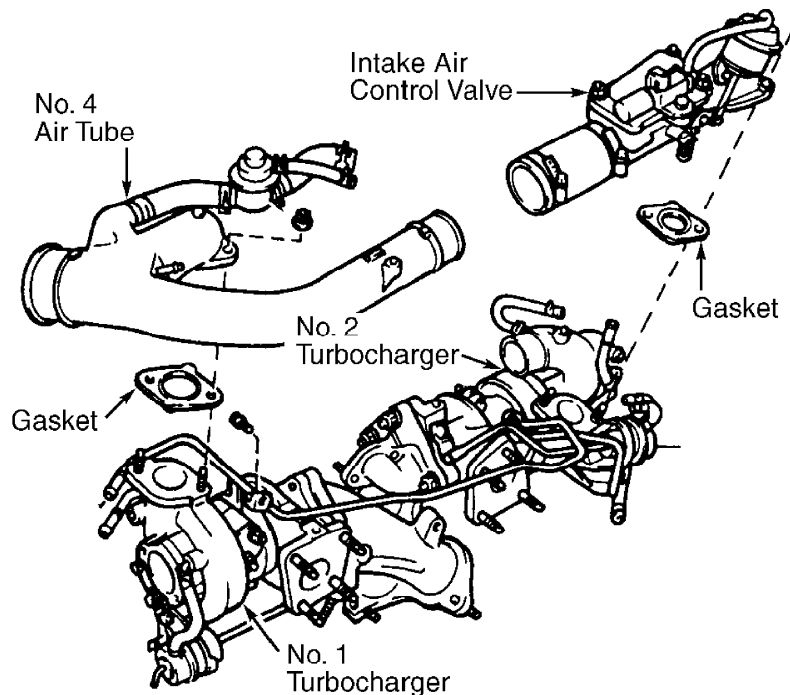
System consists of 2 turbochargers. See Fig. 5. While No. 1 turbocharger provides boost pressure at low engine RPM and engine load conditions, both turbochargers together provide boost pressure at high engine RPM and engine load conditions. System is equipped with a Charge Air Cooler (CAC) to cool turbocharger intake air. Cooling of turbocharger intake air increases air density, resulting in increased engine output.

An intake air control valve is located on No. 2 turbocharger. See Fig. 5. An exhaust by-pass valve and exhaust gas control valve are used in the turbocharger system. See Fig. 6.

During low engine RPM, intake air control valve, exhaust gas control valve and wastegate are closed and only No. 1 turbocharger provides boost pressure. When boost pressure reaches a predetermined level, exhaust by-pass valve opens. When exhaust by-pass valve opens, exhaust gas is delivered to No. 2 turbocharger and No. 2 turbocharger operates to provide additional boost pressure.

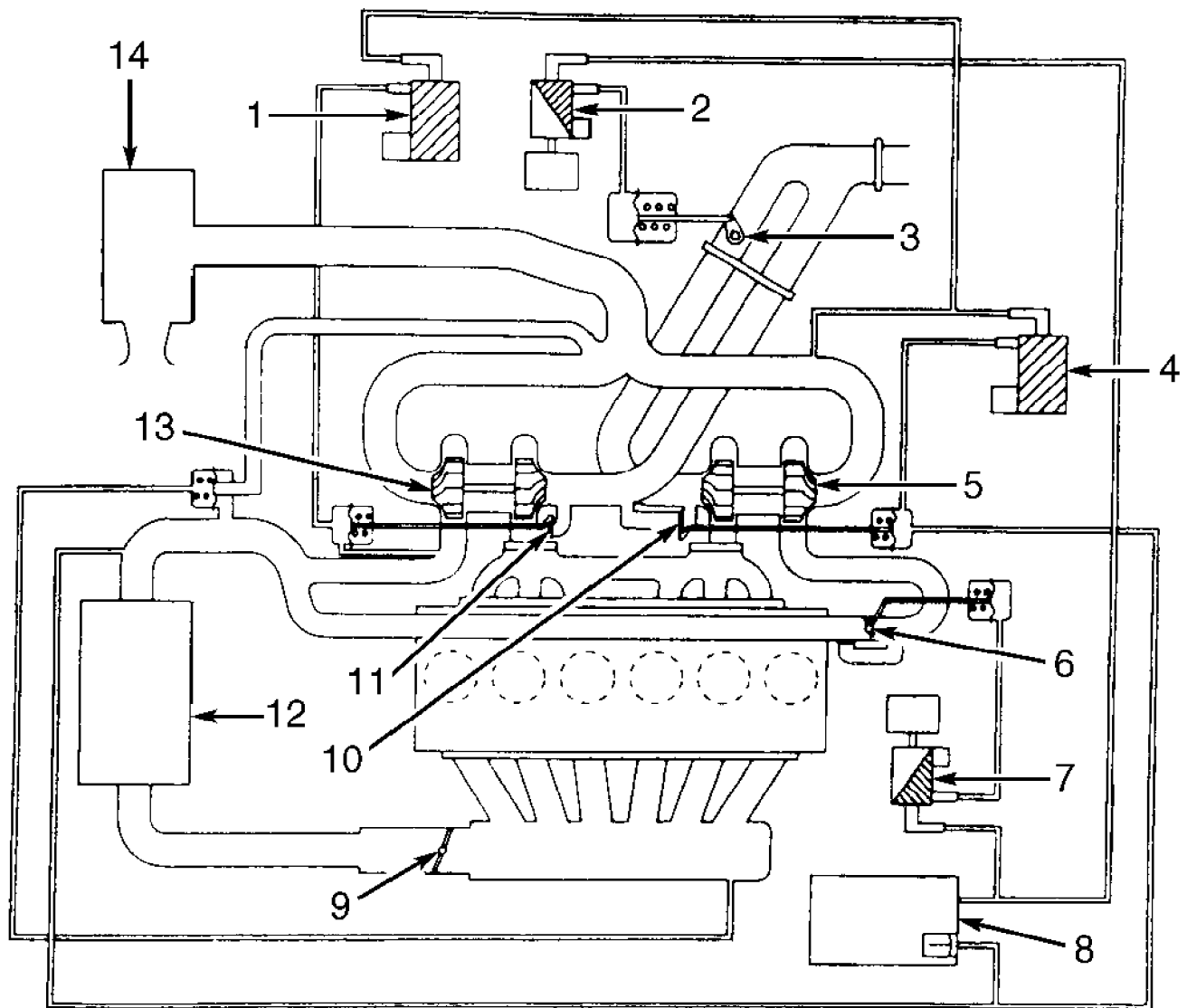
During high engine RPM, exhaust gas control valve and intake air control valve are opened. This allows No. 1 and 2 turbochargers to provide boost pressure. At this time, even if exhaust by-pass valve operates, it cannot affect boost pressure, since it is downstream of No. 2 turbocharger. During high engine RPM, the wastegate controls boost pressure of entire system.

The Engine Control Module (ECM) controls the wastegate, exhaust gas control valve and exhaust by-pass valve operation by using a Vacuum Switching Valve (VSV) for each component. The ECM uses various input signals for determining VSV operation. The VSV controls the pressure flow to an actuator for the wastegate, exhaust gas control valve and exhaust by-pass valve.



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Fig. 5: Locating No. 1 & 2 Turbochargers (Supra Turbo)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



1. Wastegate VSV

2. Exhaust Gas Control Valve VSV

3. Exhaust Gas Control Valve

4. Exhaust By-Pass Valve VSV

5. No. 2 Turbocharger

6. Intake Air Control Valve

7. Intake Air Control Valve VSV

8. Pressure Tank

9. Throttle Valve

10. Exhaust By-Pass Valve

11. Wastegate

12. Charge Air Cooler (CAC)

13. No. 1 Turbocharger

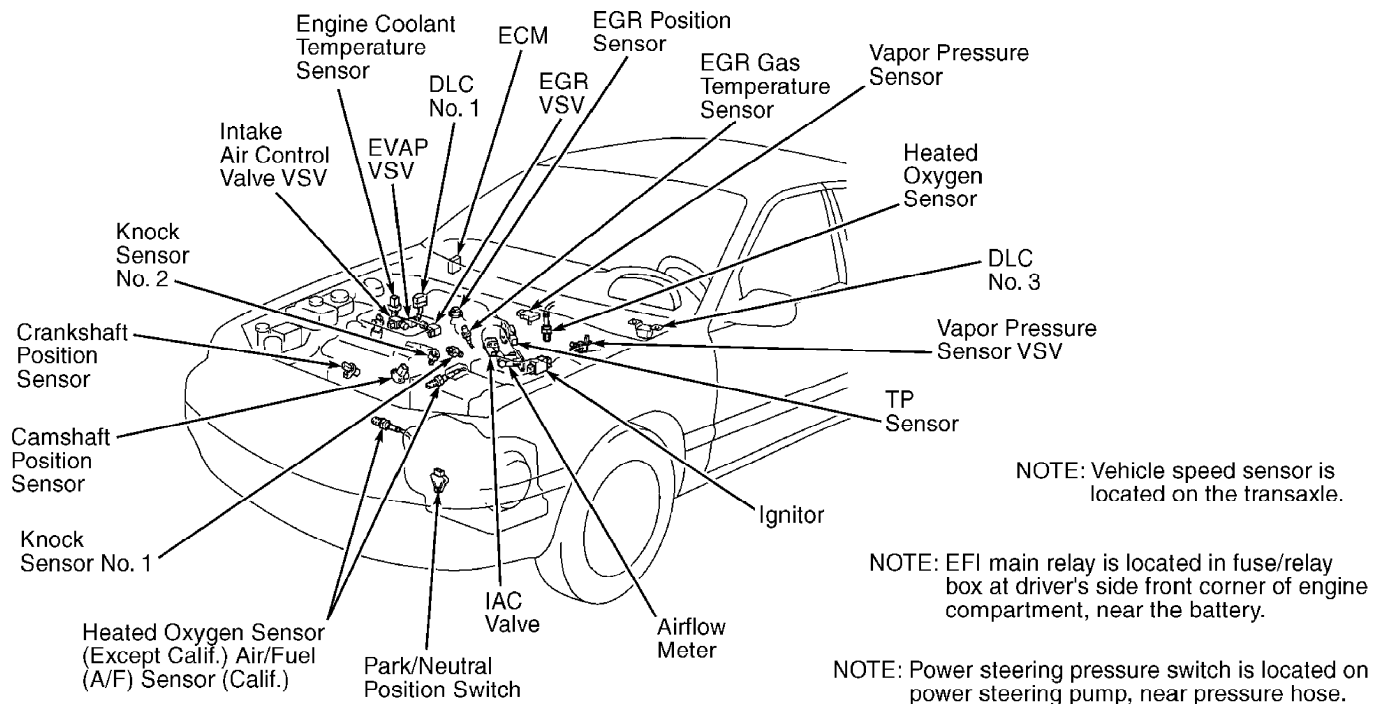
14. Air Cleaner

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Fig. 6: Identifying Turbocharger System Components (Supra Turbo)
 Courtesy of Toyota Motor Sales, U.S.A., Inc.

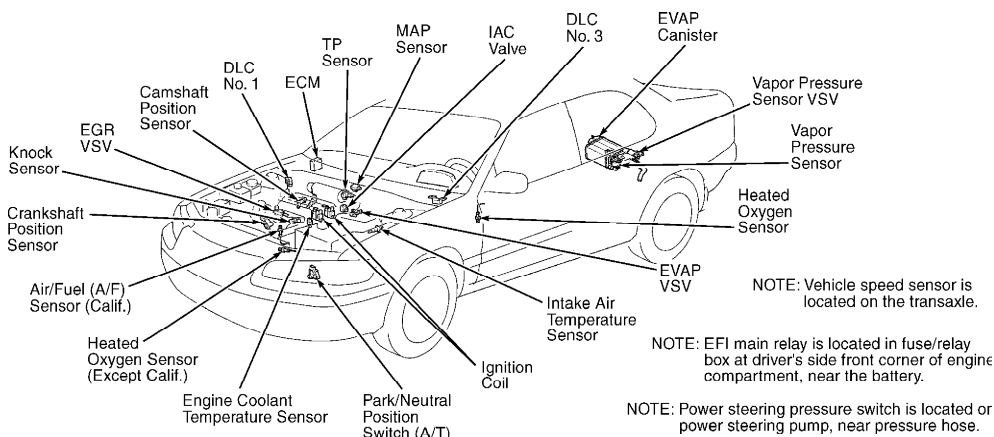
ENGINE CONTROL SYSTEM

Engine control system is a computerized emission, ignition and fuel injection control system. Engine control system lowers exhaust emissions while maintaining good fuel economy and driveability. Engine control system consists of various sensors, switches and control units. See Figs. 7-23. An Engine Control Module (ECM) controls engine control system based on input signals received from various input devices. The ECM contains preprogrammed data to maintain optimum engine performance under all operating conditions.



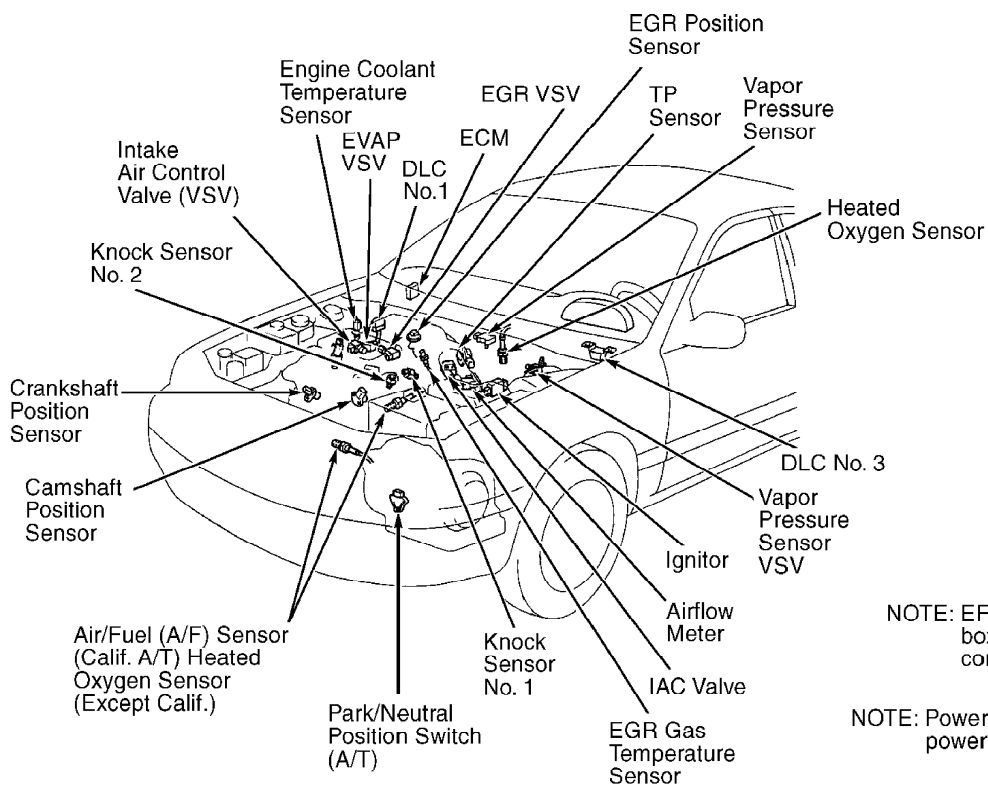
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Fig. 7: Locating Engine Control System Components (Avalon)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



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Fig. 8: Locating Engine Control System Components (Camry 2.2L 4-Cyl.)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

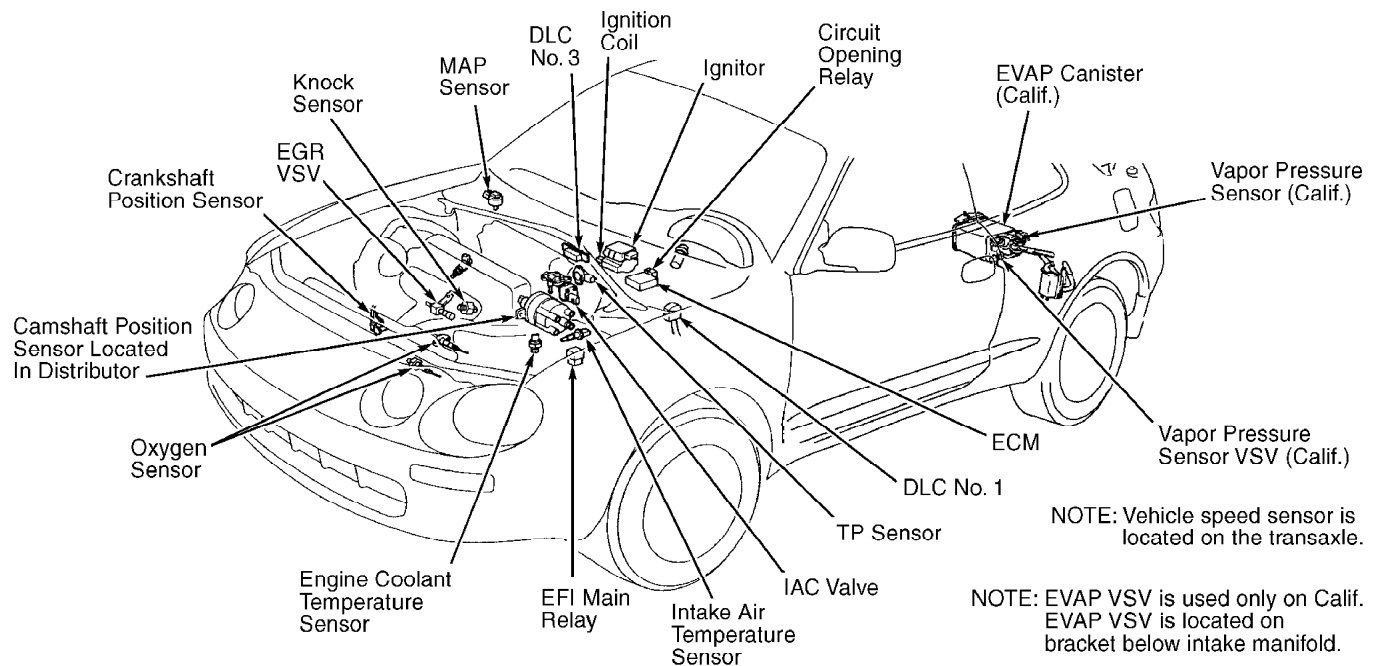


NOTE: Vehicle speed sensor is located on the transaxle.

NOTE: EFI main relay is located in fuse/relay box at driver's side front corner of engine compartment, near the battery.

NOTE: Power steering pressure switch is located on power steering pump, near pressure hose.

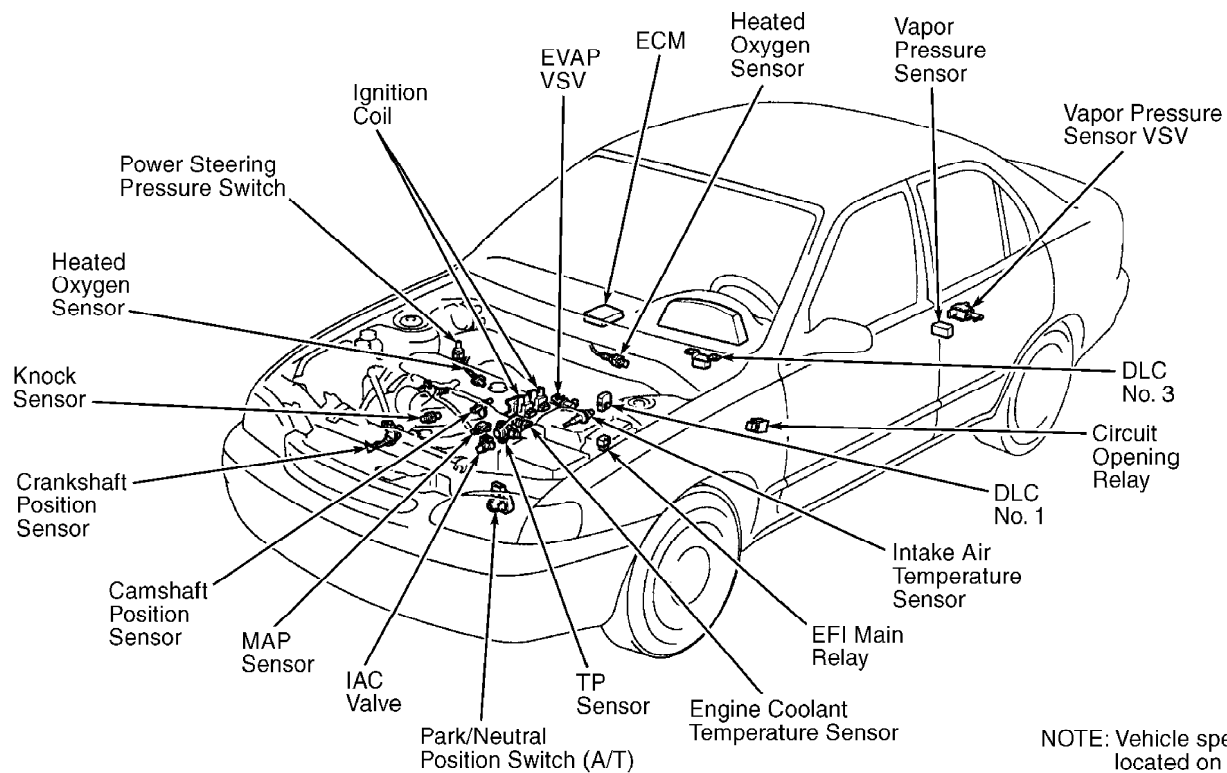
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Fig. 9: Locating Engine Control System Components (Camry 3.0L V6)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



NOTE: Vehicle speed sensor is located on the transaxle.

NOTE: EVAP VSV is used only on Calif. EVAP VSV is located on bracket below intake manifold.

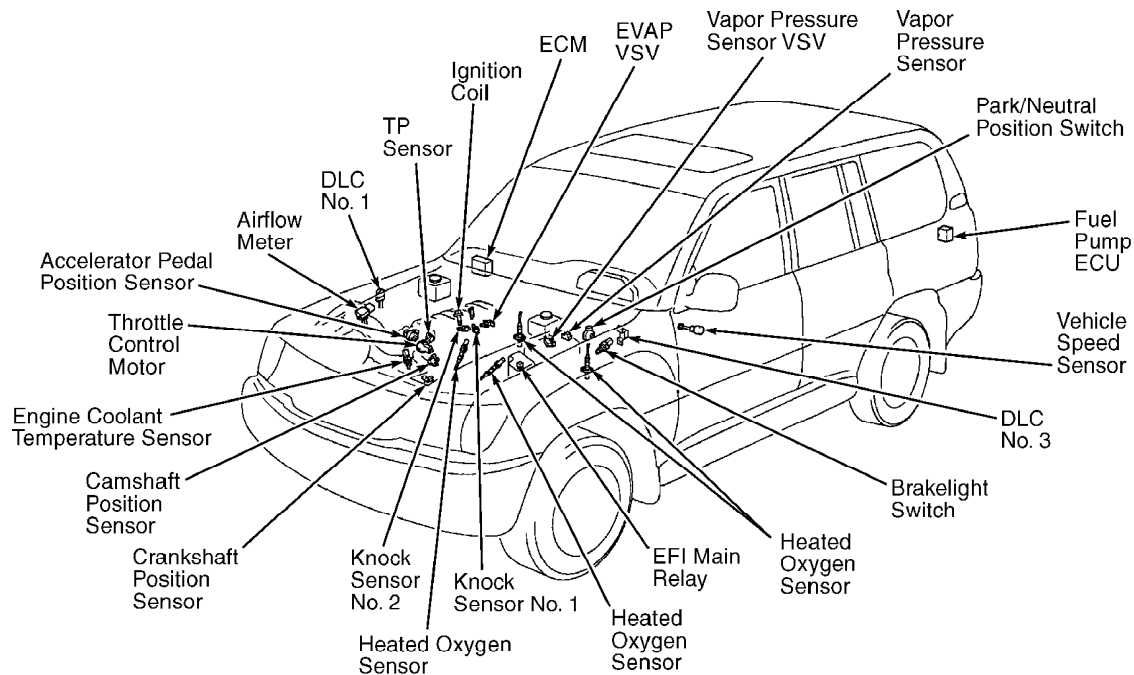
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Fig. 10: Locating Engine Control System Components (Celica)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



NOTE: Vehicle speed sensor is located on the transaxle.

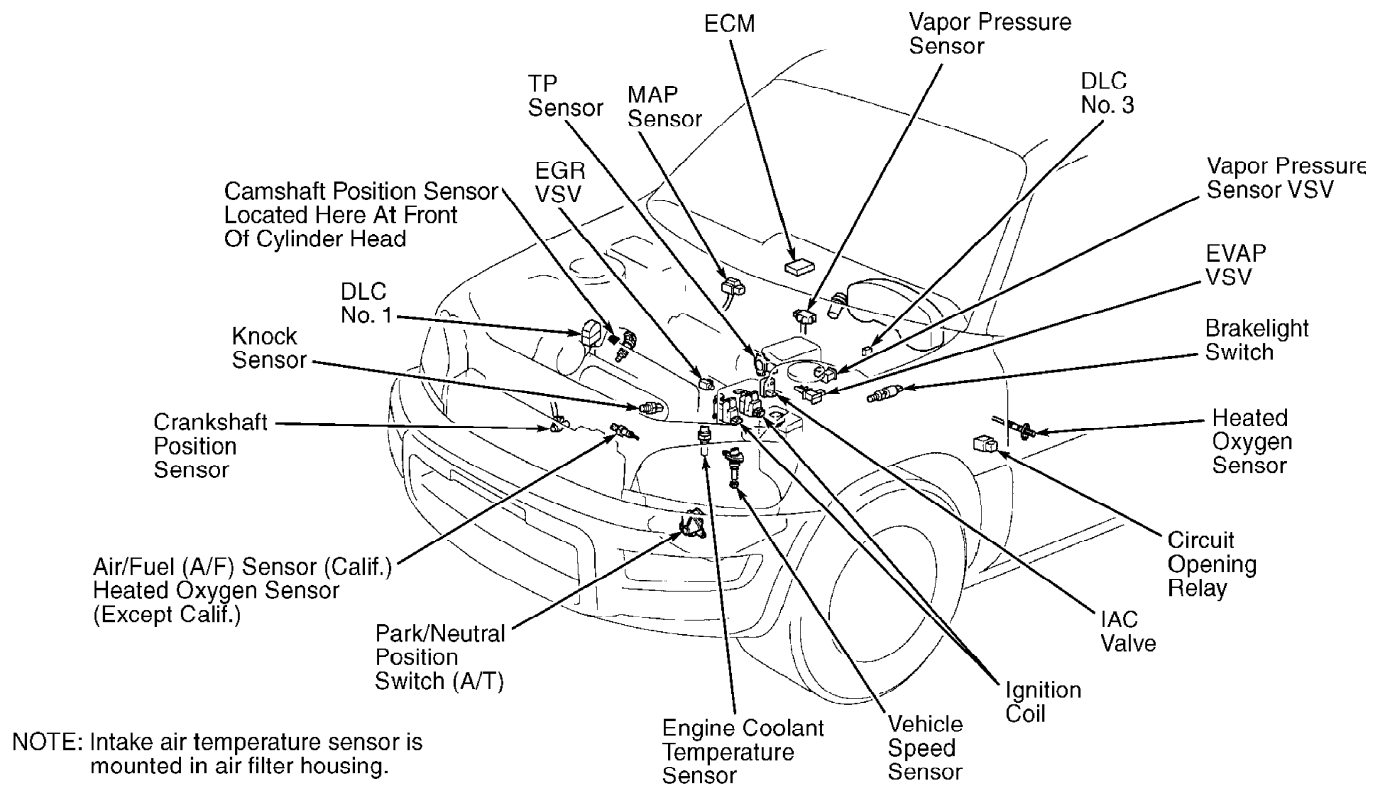
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Fig. 11: Locating Engine Control System Components (Corolla)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

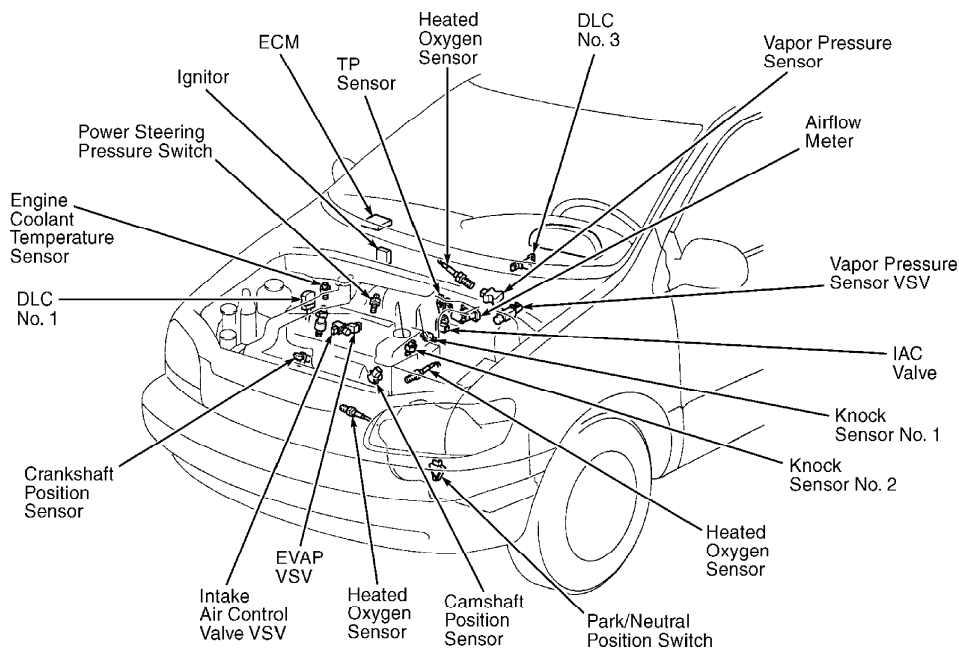


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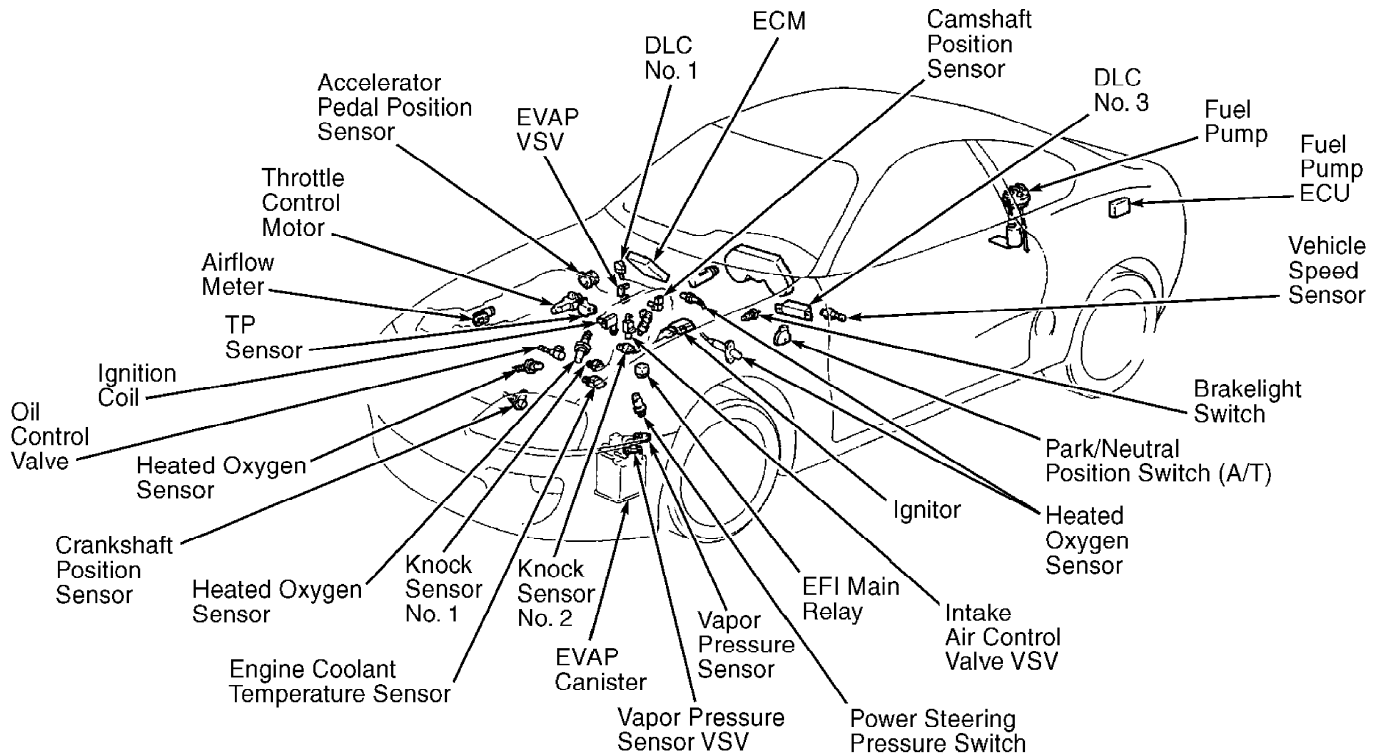
Fig. 12: Locating Engine Control System Components (Land Cruiser & LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



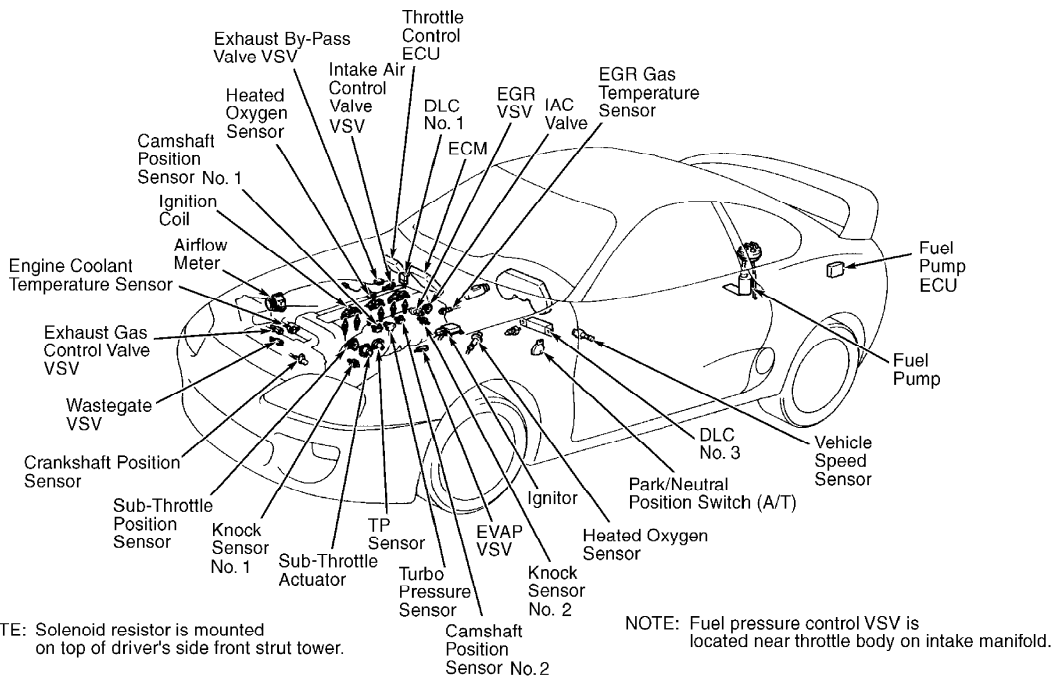
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Fig. 13: Locating Engine Control System Components (RAV4)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



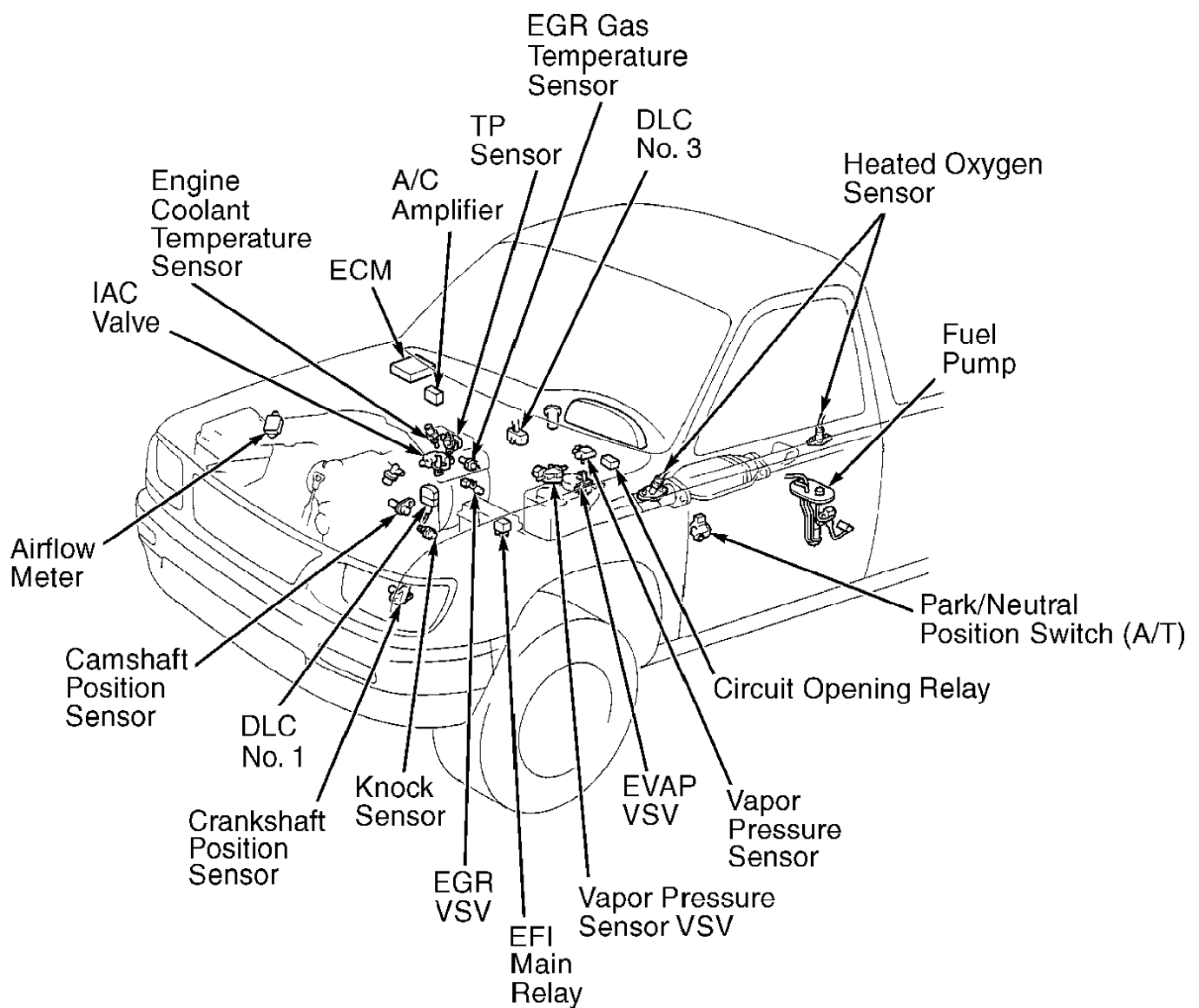
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Fig. 14: Locating Engine Control System Components (Sienna)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



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Fig. 15: Locating Engine Control System Components (Supra Non-Turbo)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



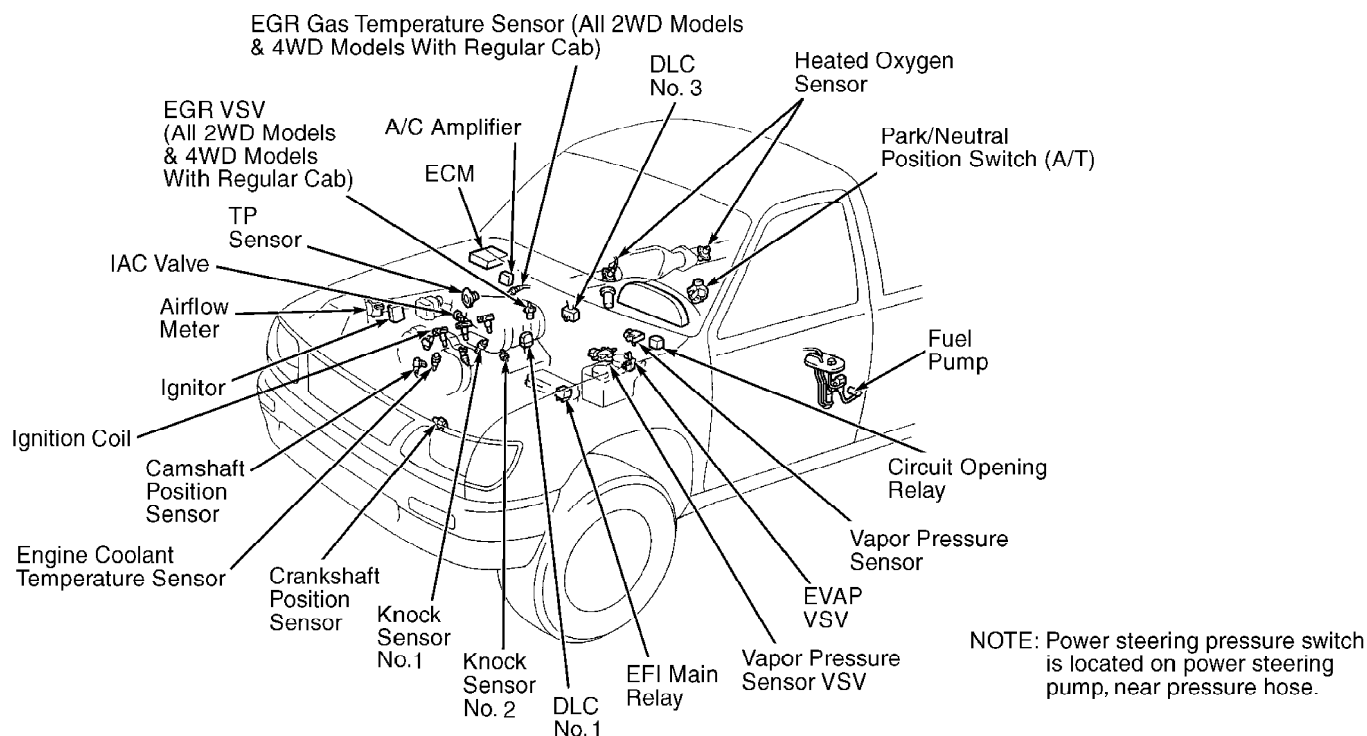
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Fig. 16: Locating Engine Control System Components (Supra Turbo)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



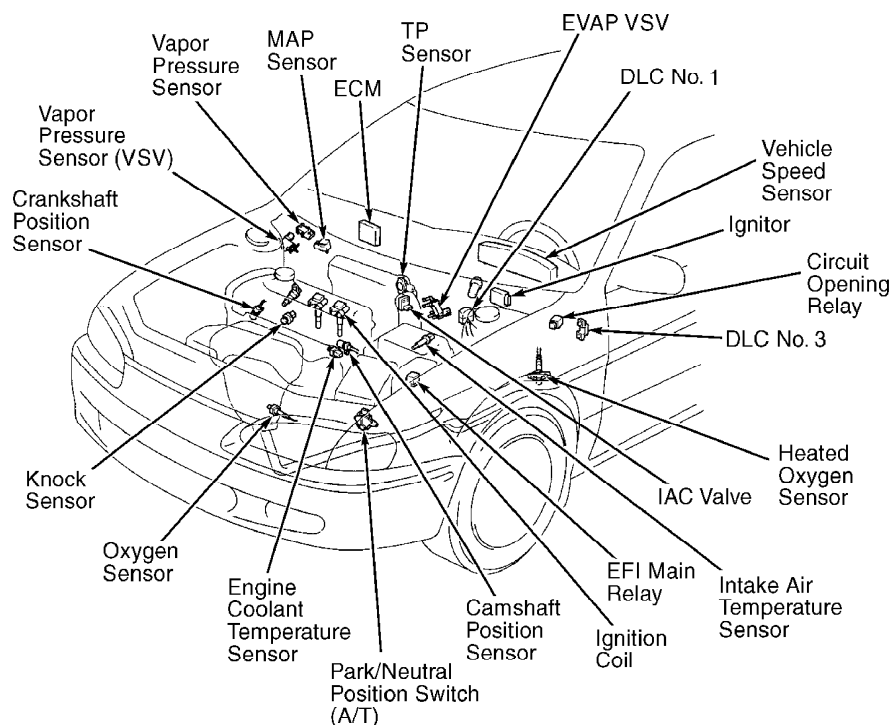
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Fig. 17: Locating Engine Control System Components (Tacoma 2.4L 4-Cyl. & 2.7L 4-Cyl.)

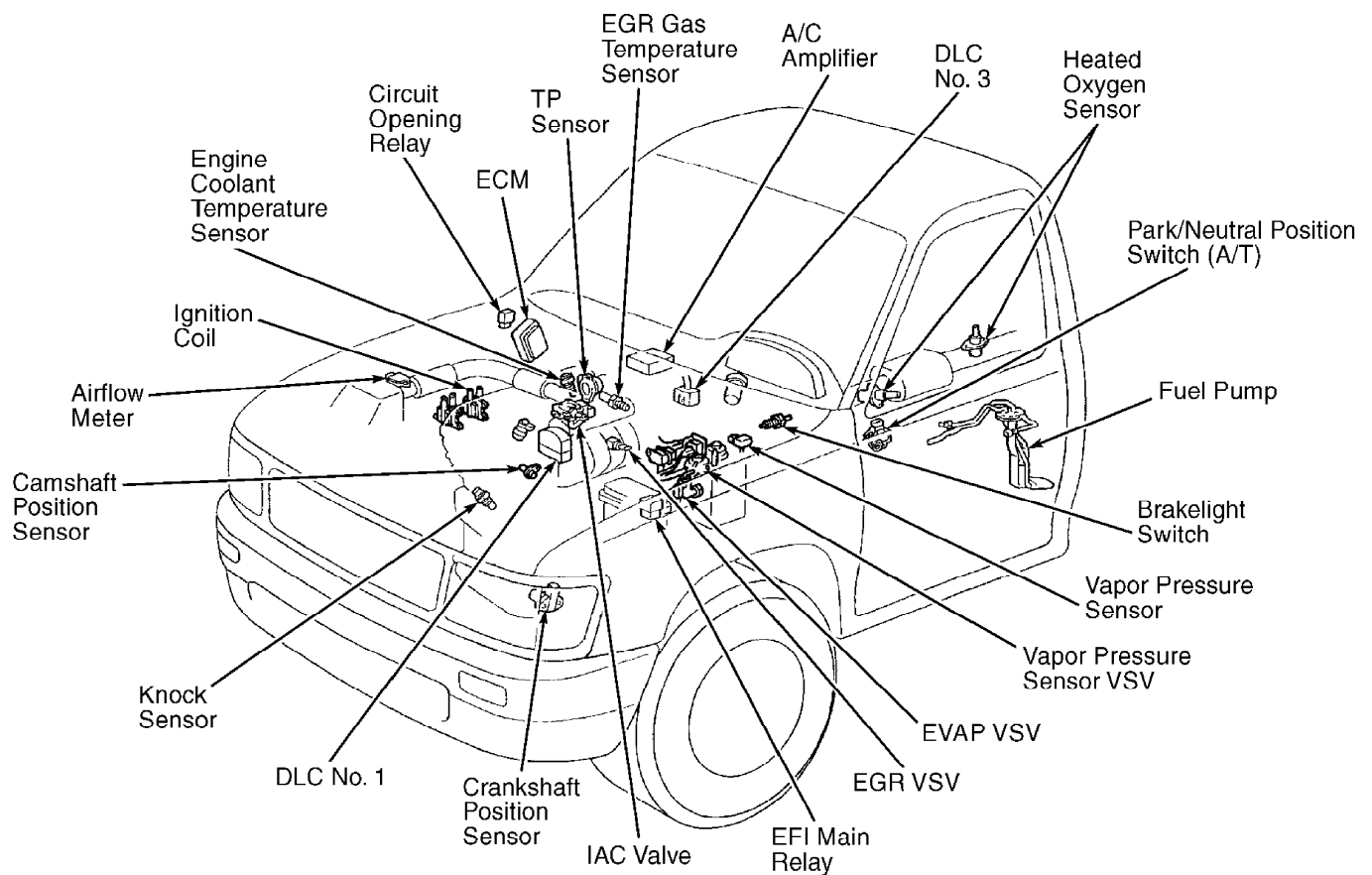
Courtesy of Toyota Motor Sales, U.S.A., Inc.



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Fig. 18: Locating Engine Control System Components (Tacoma 3.4L V6)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

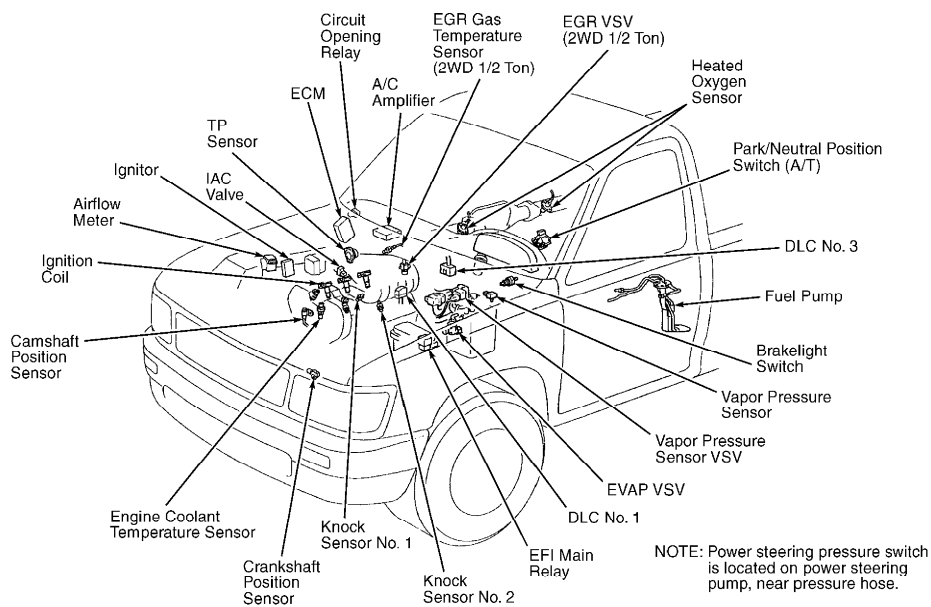


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Fig. 19: Locating Engine Control System Components (Tercel)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



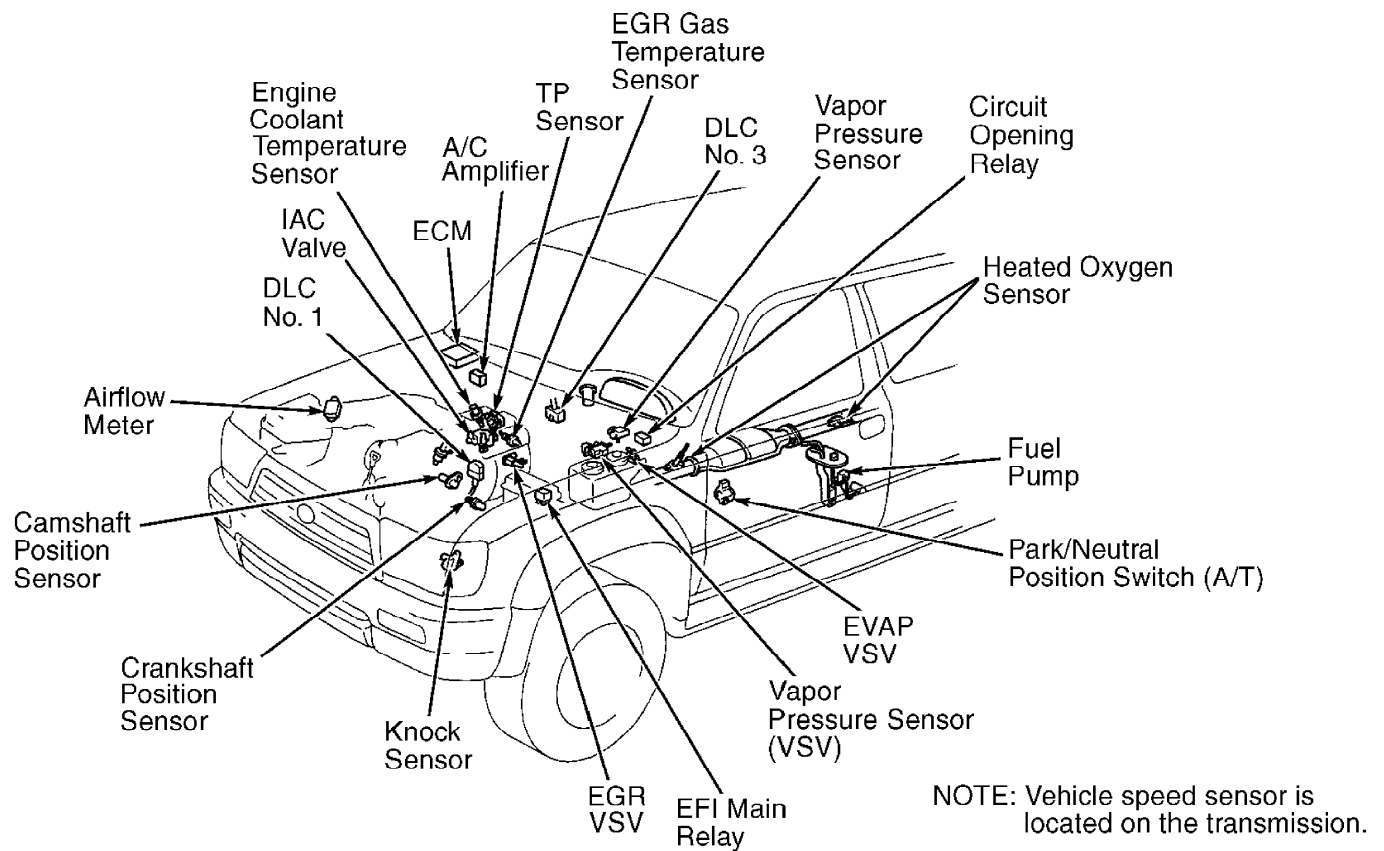
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Fig. 20: Locating Engine Control System Components (T100 2.7L 4-Cyl.)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



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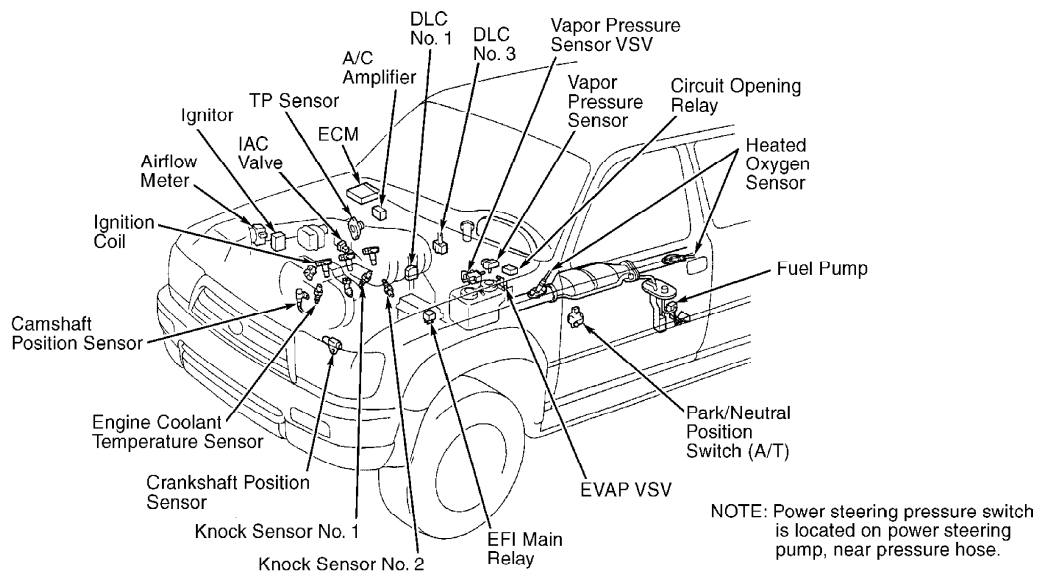
Fig. 21: Locating Engine Control System Components (T100 3.4L V6)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



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Fig. 22: Locating Engine Control System Components (4Runner 2.7L 4-Cyl.)

Courtesy of Toyota Motor Sales, U.S.A., Inc.



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Fig. 23: Locating Engine Control System Components (4Runner 3.4L V6)

Courtesy of Toyota Motor Sales, U.S.A., Inc.

ENGINE IMMOBILIZER SYSTEM

NOTE: On Avalon, engine immobilizer system is an option on XL models and standard feature on XLS models. On Camry, engine immobilizer system is an option on LE models and standard feature on XLE models. On Land Cruiser & LX470, engine immobilizer system is a standard feature on all models.

Avalon, Camry, Land Cruiser & LX470

Engine immobilizer system is a theft deterrent system that disables engine from starting by not allowing fuel injector operation and ignition system operation unless ignition key identification code matches identification code stored in the Engine Control Module (ECM). Engine immobilizer system consists of ignition key with transponder chip, transponder key coil, transponder key amplifier and ECM.

Transponder chip is incorporated into the ignition key. When ignition key is inserted into the ignition lock cylinder, the ECM instructs transponder key coil on ignition lock cylinder to supply an electromagnetic energy that enables transponder chip to transmit an ignition key identification code signal.

Transponder key amplifier then amplifies the ignition key identification code signal and delivers ignition key identification code signal to the ECM. The ECM compares received ignition key identification code signal to identification code stored in the ECM. If ignition key identification code and identification code in the ECM match, ECM will allow fuel injector operation and ignition system operation. If ignition key identification codes and identification code in the ECM do not match, ECM will not allow fuel injector operation and ignition system operation. For additional information on system operation and testing, see appropriate ENGINE IMMOBILIZER SYSTEMS article in ACCESSORIES/SAFETY EQUIPMENT section.

ENGINE CONTROL MODULE (ECM)

The ECM monitors and controls vehicle emissions, fuel system, ignition system and other various systems by using input signals from various input devices. The ECM processes input signals from input devices and delivers output signals to various components for controlling system operation to achieve optimum engine performance for all operating conditions. See the following under COMPUTERIZED ENGINE CONTROLS:

- * INPUT DEVICES.
- * OUTPUT SIGNALS.

The ECM contains a fail-safe function, used in case of sensor or switch failure. Fail-safe function uses preprogrammed values to provide a limp-in mode for minimal driveability. If a failure exists, ECM will inform the driver by turning on Malfunction Indicator Light (MIL) on the instrument panel.

NOTE: The MIL may also be referred to as the CHECK ENGINE light.

The ECM contains a self-diagnostic system which may store a Diagnostic Trouble Code (DTC) if an electronic control system failure exists. DTC may be retrieved from ECM for system diagnosis by using a scan tool. Refer to SELF-DIAGNOSTIC SYSTEM. For ECM location, refer to ECM LOCATION table.

ECM LOCATION TABLE

| Model | Location |
|----------------|---|
| Avalon & Camry | Behind Glove Box |
| Celica | Below Passenger's Side Of Instrument Panel, |

| | |
|----------------------------|--|
| | Underneath Carpet Near Center Console |
| Corolla | Behind Stereo On Instrument Panel, Just In Front Of Center Console |
| Land Cruiser & LX470 | Above Glove Box, Near Passenger's Side Of Instrument Panel |
| RAV4 | Behind Instrument Panel, Near Front Of Center Console |
| Sienna | Passenger's Side Of Instrument Panel, Just Below Glove Box |
| Supra | Below Passenger's Side Of Instrument Panel, Underneath Carpet On The Floor, Below Glove Box |
| Tacoma & Tercel | Behind Glove Box |
| T100 | Behind Passenger's Side Kick Panel |
| 4Runner | Behind Glove Box |

VARIABLE VALVE TIMING (VVT) SYSTEM

NOTE: The VVT system may also be referred to as the Variable Valve Timing-Intelligent (VVT-I or VVT-i) system.

Supra Non-Turbo

The VVT system controls intake camshaft valve timing to provide improved torque, improved fuel economy and reduce exhaust emissions. VVT system consists of oil control valve, intake camshaft sprocket, crankshaft position sensor, camshaft position sensor, oil pump and Engine Control Module (ECM). See Fig. 24.

Intake camshaft sprocket consists of an outer gear that is driven by the timing belt, inner gear that attaches to intake camshaft and a piston that moves between inner and outer gears. See Fig. 25. When the piston moves, the helical splines on the piston cause the inner and outer gear positions to change, resulting in a change in valve timing.

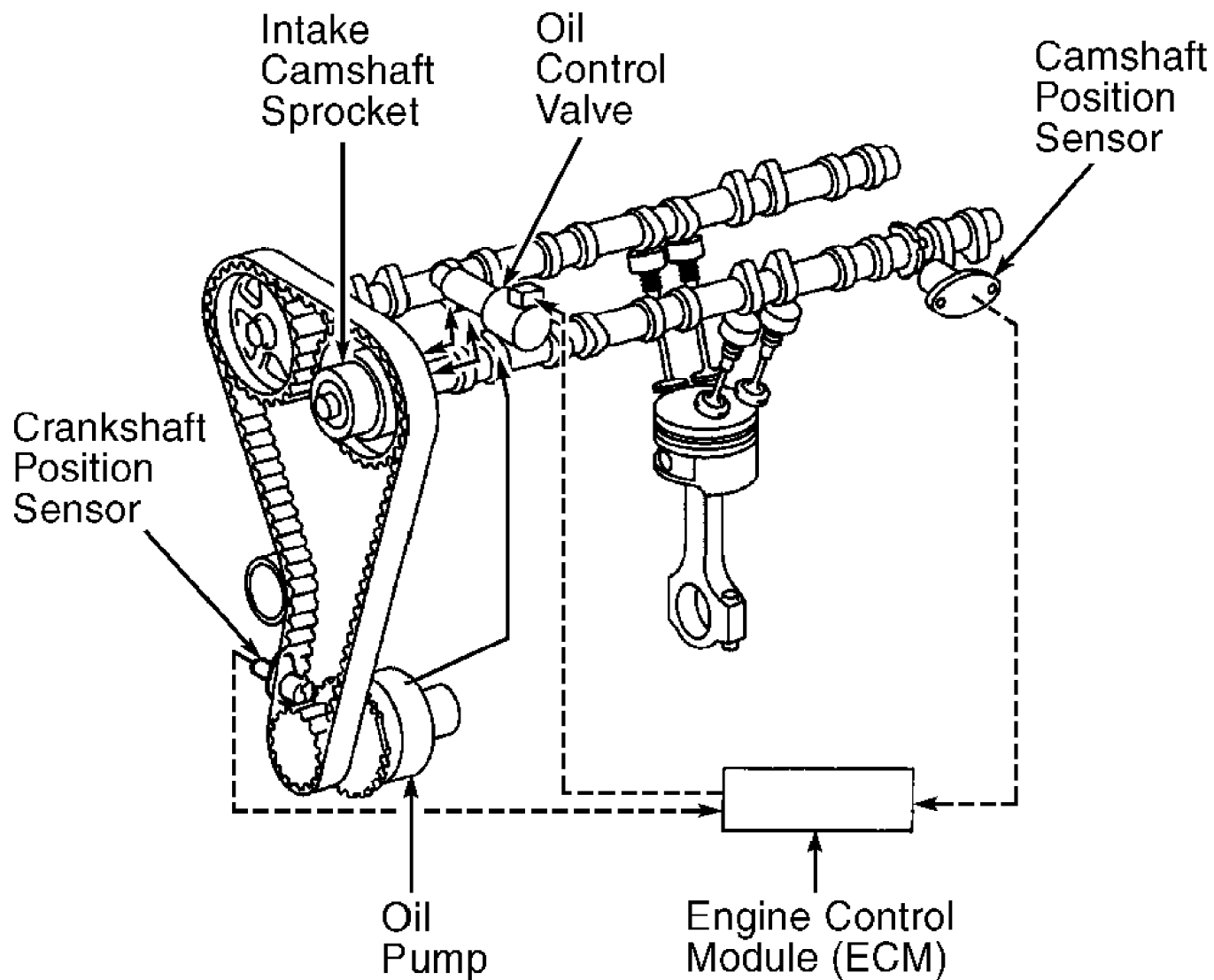
NOTE: Intake camshaft sprocket may also be referred to as VVT controller. Oil control valve may also be referred to as OCV or camshaft timing oil control valve.

Piston movement is determined by the oil control valve. The oil control valve is an electrically controlled valve that receives oil pressure from the oil pump. The ECM uses input signals for engine speed, intake air volume, throttle position and engine coolant temperature to determine the operation of the oil control valve. ECM also uses input signals from camshaft position sensor and crankshaft position sensor for determining the actual intake camshaft valve timing. The ECM operates the oil control valve by controlling position of spool valve in the oil control valve. Positioning of spool valve determines which side of the piston the oil pressure will be applied on. By applying oil pressure on the piston, the piston will move inward or outward, causing the intake camshaft valve timing to change.

When the engine is started or shut off, the oil control valve is positioned so intake camshaft valve timing is retarded. When engine is idling or during low load, intake camshaft valve timing is retarded to provide stable engine operation. During medium load, intake camshaft valve timing is advanced. During high load in low to medium speed range, intake camshaft valve timing is advanced to provide increased torque. During high load in high speed range, intake camshaft valve timing is retarded to provide improved high speed range operation. During cold temperature operation, intake camshaft valve timing is retarded to provide stable idle and increased fuel economy due to the lower fast idle speed.

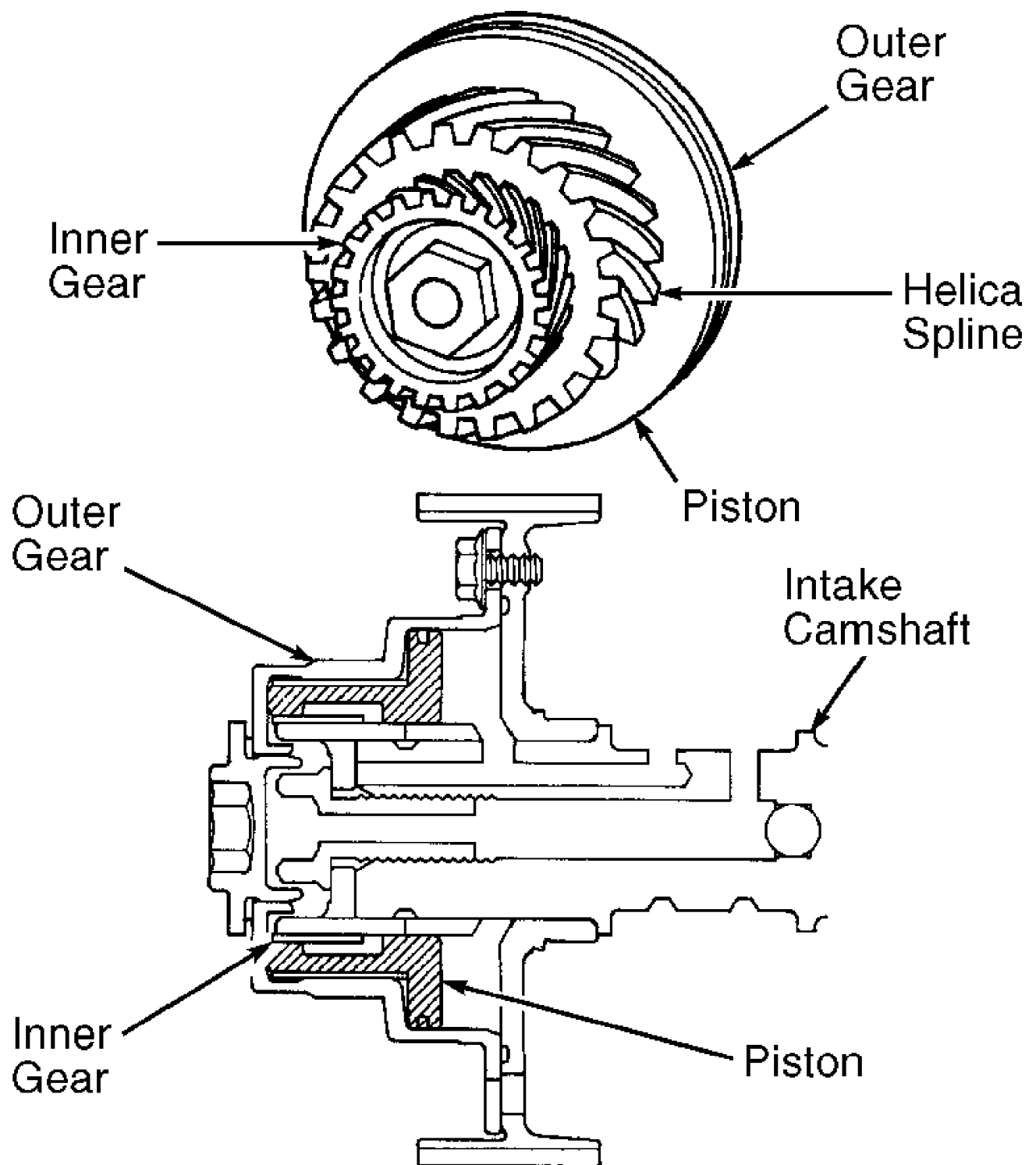
If a problem exists in the VVT system, a Diagnostic Trouble Code (DTC) may be stored in the ECM. DTC may be retrieved from ECM for

system diagnosis by using a scan tool. See SELF-DIAGNOSTIC SYSTEM.



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Fig. 24: Locating VVT System Components (Supra Non-Turbo)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



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Fig. 25: Locating Piston & Gears For VVT System (Supra Non-Turbo)
 Courtesy of Toyota Motor Sales, U.S.A., Inc.

NOTE: Components are grouped into 2 categories. The first category covers INPUT DEVICES, which control or produce voltage

signals monitored by the Engine Control Module (ECM). The second category covers OUTPUT SIGNALS, which are components controlled by the ECM.

INPUT DEVICES

Vehicles are equipped with different combinations of input devices. Not all devices are used on all models. To determine the input device usage on a specific model, see appropriate wiring diagram in L - WIRING DIAGRAMS article. The available input signals include the following:

Accelerator Pedal Position Sensor (Land Cruiser, LX470 & Supra Non - Turbo)

Accelerator pedal position sensor is used with the ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) for controlling of the throttle operation. See ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) under AIR INDUCTION SYSTEM for additional information.

Air/Fuel (A/F) Sensor (Avalon Calif. Emission Vehicles, Camry 2.2L 4-Cyl. Calif. Emission Vehicles, Camry 3.0L V6 Calif. Emission Vehicles With A/T & RAV4 Calif. Emission Vehicles)

The heated Air/Fuel (A/F) sensor monitors exhaust gas oxygen content and delivers an input signal to Engine Control Module (ECM). The ECM may use input signal to control fuel injection system. See A/F SENSOR LOCATION table.

A/F SENSOR LOCATION TABLE

| Application | Sensor Location |
|------------------------|------------------------------|
| Avalon | One On Each Exhaust Manifold |
| Camry | |
| 2.2L 4-Cyl. | On Exhaust Manifold |
| 3.0L V6 With A/T | One On Each Exhaust Manifold |
| RAV4 | On Exhaust Manifold |

A/C Switch (All Models)

When A/C is turned on, input signal is delivered to Engine Control Module (ECM). The ECM uses input signal to control engine idle speed during A/C operation.

NOTE: Airflow meter may also be referred to as Mass Airflow (MAF) meter.

Airflow Meter (Avalon, Camry 3.0L V6, Land Cruiser, LX470, Sienna, Supra, Tacoma, T100 & 4Runner)

Airflow meter measures intake airflow volume. Input signal for airflow volume is sent from airflow meter to Engine Control Module (ECM). The ECM may use input signal for determining ignition timing (spark advance) and for controlling fuel injection system. Airflow meter also contains an intake air temperature sensor which is used to measure intake air temperature. See INTAKE AIR TEMPERATURE SENSOR under INPUT DEVICES.

Battery Signal (Avalon, Camry, Celica, RAV4, Sienna, Tacoma, Tercel, T100 & 4Runner)

Battery voltage is always present at BATT terminal of Engine Control Module (ECM). When ignition is turned on, voltage for ECM operation is applied through EFI main relay to +B terminal on ECM. EFI main relay may also be referred to as EFI relay.

Battery Signal (Corolla)

Battery voltage is always present at BATT terminal of Engine Control Module (ECM). When ignition is turned on, voltage for ECM operation is applied through EFI main relay to +B terminal on ECM. EFI main relay may also be referred to as EFI relay or F-HTR relay.

Battery Signal (Land Cruiser & LX470)

Battery voltage is always present at BATT and +BM terminals of Engine Control Module (ECM). When ignition is turned on, voltage for ECM operation is applied through EFI main relay to +B and +B1 terminals on ECM. EFI main relay may also be referred to as EFI relay or ECD relay. Voltage is applied to IGSW terminal on ECM through the IGN fuse.

Battery Signal (Supra Non-Turbo)

Battery voltage is always present at BATT terminal of Engine Control Module (ECM). When ignition is turned on, voltage for ECM operation is applied through EFI main relay to +B and +B2 terminals on ECM. EFI main relay may also be referred to as EFI relay. Voltage is applied to IGSW terminal on ECM through the IGN fuse.

Battery Signal (Supra Turbo)

Battery voltage is always present at BATT terminal of Engine Control Module (ECM). When ignition is turned on, voltage for ECM operation is applied through EFI main relay to +B terminal on ECM. EFI main relay may also be referred to as EFI relay. Voltage is applied to IGSW terminal on ECM through the IGN fuse.

Brakelight Signal (Avalon, Camry, Corolla With A/T, Land Cruiser, Sienna & Supra)

Brakelight switch delivers an input signal to STP terminal of Engine Control Module (ECM) to indicate when brakes are applied.

Brakelight Signal (Celica, RAV4 With A/T, Tacoma, T100 & 4Runner)

Brakelight switch delivers an input signal to BK terminal of Engine Control Module (ECM) to indicate when brakes are applied.

Camshaft & Crankshaft Position Sensors (Avalon & Camry 3.0L V6)

Camshaft position sensor and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensor is located at flywheel end of front cylinder head, just below valve cover. Crankshaft position sensor is located at front of crankshaft, near crankshaft pulley. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system, idle speed control system, EGR system, heated oxygen sensor system and intake air control valve system.

Camshaft & Crankshaft Position Sensors (Camry 2.2L 4-Cyl.)

Camshaft position sensor and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensor is located at timing belt end of cylinder head, on the firewall side of the engine. Crankshaft position sensor is located at timing belt end of engine, behind timing belt cover, near sprocket on crankshaft. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system and idle speed control system.

Camshaft & Crankshaft Position Sensors (Celica)

Camshaft position sensor and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensor is a pick-up coil located in the distributor.

Crankshaft position sensor is located at timing belt end of engine, behind timing belt cover, near sprocket on crankshaft. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system, A/C-cut control system and EGR system.

Camshaft & Crankshaft Position Sensors (Corolla)

Camshaft position sensor and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensor is located just above the intake manifold on cylinder head, at flywheel end of engine. Crankshaft position sensor is located on front of engine, near crankshaft pulley. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system and idle speed control system.

Camshaft & Crankshaft Position Sensors (Land Cruiser & LX470)

Camshaft position sensor and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensor is located behind driver's side upper timing belt cover, near camshaft sprocket. Crankshaft position sensor is located at front of crankshaft, near crankshaft pulley. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system.

Camshaft & Crankshaft Position Sensors (RAV4)

Camshaft position sensor and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensor is located at timing belt end of cylinder head, on the firewall side of the engine. Crankshaft position sensor is located at timing belt end of engine, behind timing belt cover, near sprocket on crankshaft. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system and idle speed control system.

Camshaft & Crankshaft Position Sensors (Sienna)

Camshaft position sensor and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensor is located at flywheel end of front cylinder head, just below valve cover. Crankshaft position sensor is located at front of crankshaft, near crankshaft pulley. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system, idle speed control system, heated oxygen sensor system and intake air control valve system.

Camshaft & Crankshaft Position Sensors (Supra Non-Turbo)

Camshaft position sensor and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensor is located just above the intake manifold on rear corner of cylinder head, just below the valve cover. Crankshaft position sensor is located near crankshaft pulley, just above oil pan on passenger's side of engine. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system and heated oxygen sensor system.

Camshaft & Crankshaft Position Sensors (Supra Turbo)

Camshaft position sensors and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensors are located on intake manifold side of cylinder head. Crankshaft position sensor is located near crankshaft pulley, just above oil pan on passenger's side of engine. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system, heated oxygen sensor system, idle speed control system and EGR system.

Camshaft & Crankshaft Position Sensors (Tacoma 2.4L 4-Cyl. & 2.7L 4-Cyl., T100 2.7L 4-Cyl. & 4Runner 2.7L 4-Cyl.)

Camshaft position sensor and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensor is located at driver's side front corner of cylinder head, just in front of the intake manifold. Crankshaft position sensor is located near crankshaft pulley, just above oil pan on driver's side of engine. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system and heated oxygen sensor system.

Camshaft & Crankshaft Position Sensors (Tacoma 3.4L V6, T100 3.4L V6 & 4Runner 3.4L V6)

Camshaft position sensor and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensor is located behind timing belt cover, near passenger's side camshaft sprocket. Crankshaft position sensor is located at front of engine, just above crankshaft pulley. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system and heated oxygen sensor system.

Camshaft & Crankshaft Position Sensors (Tercel)

Camshaft position sensor and crankshaft position sensor deliver input signals to Engine Control Module (ECM). Camshaft position sensor is located on end of cylinder head, just above the flywheel. Crankshaft position sensor is located at timing belt end of engine, behind timing belt cover, near sprocket on crankshaft. The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system, idle speed control system and A/C-cut control system.

EGR Gas Temperature Sensor (Avalon, Camry 3.0L V6, Supra Turbo, Tacoma 2.4L 4-Cyl & 2.7L 4-Cyl., Tacoma 3.4L V6 2WD All Models & 4WD Regular Cab, T100 2.7L 4-Cyl., T100 3.4L V6 2WD 1/2 Ton & 4Runner 2.7L 4-Cyl.)

EGR gas temperature sensor monitors EGR gas temperature and delivers an input signal to Engine Control Module (ECM). EGR gas temperature sensor is located near EGR valve.

EGR Position Sensor (Avalon & Camry 3.0L V6)

The EGR position sensor monitors movement of EGR valve and delivers an input signal to the ECM. The ECM uses this input signal to obtain the correct amount of EGR valve opening in relation to the engine operation. EGR position sensor is mounted on the EGR valve.

Electrical Load Signal (Avalon, Camry 3.0L V6, Sienna & Supra Non-Turbo)

An input signal is delivered to ELS and ELS2 terminals of Engine Control Module (ECM) to indicate when high electrical output is required. This signal is delivered when items such as headlights or rear window defroster are turned on. The ECM uses input signal to maintain proper idle speed.

Electrical Load Signal (Camry 2.2L 4-Cyl., Celica, RAV4 & Supra Turbo)

An input signal is delivered to ELS terminal of Engine Control Module (ECM) to indicate when high electrical output is required. This signal is delivered when items such as rear window defroster or headlights are turned on. The ECM uses input signal to maintain proper idle speed.

Electrical Load Signal (Corolla)

An input signal is delivered to ELS1 and ELS2 terminals of Engine Control Module (ECM) to indicate when high electrical output is required. This signal is delivered when items such as rear window defroster or headlights are turned on. The ECM uses input signal to maintain proper idle speed.

Electrical Load Signal (Land Cruiser & LX470)

An input signal is delivered to ELS terminal of Engine Control Module (ECM) to indicate when high electrical output is required when accessories are turned on. The ECM uses input signal to maintain proper idle speed.

Engine Coolant Temperature (ECT) Sensor (All Models)

The ECT contains a built-in thermistor in which resistance varies according to engine coolant temperature. The ECT delivers an input signal to THW terminal of Engine Control Module (ECM). The ECM may use input signal for determining ignition timing (spark advance) and for controlling fuel injection system, overdrive operation on electronically controlled transmissions/transaxles, idle speed control system, fuel pressure control system (if equipped), heated oxygen sensor system (if equipped) and EGR system (if equipped). For ECT sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

Engine Cranking Signal (All Models)

While engine is cranking and voltage is applied to the starter, an input signal is also delivered to STA terminal of Engine Control Module (ECM). The ECM may use input signal for determining ignition timing (spark advance) and for controlling fuel injection system, heated oxygen sensor system (if equipped) and idle speed control system.

Intake Air Temperature Sensor (Avalon, Camry 3.0L V6, Land Cruiser, Sienna, Supra, Tacoma, T100 & 4Runner)

Intake air temperature sensor is located in airflow meter. Intake air temperature sensor measures incoming intake air temperature and delivers an input signal to THA terminal of Engine Control Module (ECM). The ECM may use input signal for controlling fuel injection system.

Intake Air Temperature Sensor (Camry 2.2L 4-Cyl., Celica, Corolla, RAV4 & Tercel)

Intake air temperature sensor is mounted in air filter housing. Intake air temperature sensor measures incoming intake air temperature and delivers an input signal to THA terminal of Engine Control Module (ECM). The ECM may use input signal for controlling fuel injection system.

Knock Sensor (Avalon & Camry 3.0L V6, Land Cruiser, LX470 & Sienna)

Knock sensors No. 1 and 2 monitor ignition knock conditions and deliver input signals to KNKR and KNKL terminals of Engine Control Module (ECM). The ECM may use input signals for determining ignition timing (spark advance) and for controlling fuel injection system. For knock sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

Knock Sensor (Camry 2.2L 4-Cyl., Celica, Corolla, Tacoma 2.4L 4-Cyl. & 2.7L 4-Cyl., T100 2.7L 4-Cyl. & 4Runner 2.7L 4-Cyl.)

Knock sensor monitors ignition knock conditions and delivers input signal to KNK terminal of Engine Control Module (ECM). The ECM may use input signal for determining ignition timing (spark advance) and for controlling fuel injection system. For knock sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

Knock Sensor (RAV4 & Tercel)

Knock sensor monitors ignition knock conditions and delivers input signal to KNC1 terminal of Engine Control Module (ECM). The ECM may use input signal for determining ignition timing (spark advance) and for controlling fuel injection system. For knock sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

Knock Sensor (Supra, Tacoma 3.4L V6, T100 3.4L V6 & 4Runner 3.4L V6)

Knock sensors No. 1 and 2 monitor ignition knock conditions and deliver input signals to KNC1 and KNC2 terminals of Engine Control Module (ECM). The ECM may use input signal for determining ignition timing (spark advance) and for controlling fuel injection system. For knock sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

Manifold Absolute Pressure (MAP) Sensor (Camry 2.2L 4-Cyl., Celica, Corolla, RAV4 & Tercel)

The MAP sensor monitors intake manifold intake air volume and delivers an input signal to Engine Control Module (ECM). The ECM may use input signal for determining ignition timing (spark advance) and for controlling fuel injection system.

Oxygen Sensor (All Models)

Oxygen sensor monitors exhaust gas oxygen content and delivers an input signal to Engine Control Module (ECM). The ECM may use input signal for determining ignition timing (spark advance) and for controlling fuel injection system. Some models may be equipped with more than one oxygen sensor. On some models, a heated oxygen sensor may be used. On heated oxygen sensors, a heater is used to warm the oxygen sensor to improve oxygen sensor detection operation. The heater is controlled by the ECM.

Park/Neutral Position Switch (A/T Models)

The Park/Neutral Position (PNP) switch delivers an input signal to Engine Control Module (ECM) to indicate transaxle/transmission gear position. The ECM may use input signal to control engine idle and fuel injection system.

Power Steering Pressure Switch (Avalon, Camry, Corolla, Sienna, Tacoma 3.4L V6, T100 3.4L V6 & 4Runner 3.4L V6)

Power steering pressure switch delivers an input signal to Engine Control Module (ECM) to indicate power steering pressure. The ECM may use input signal to control engine idle. Power steering pressure switch may also be referred to as power steering oil pressure switch. Power steering pressure switch is located on power steering pump, near the pressure hose.

Power Steering Pressure Switch (Supra Non-Turbo)

Power steering pressure switch delivers an input signal to Engine Control Module (ECM) to indicate power steering pressure. The ECM may use input signal to control engine idle. Power steering pressure switch may also be referred to as power steering oil pressure switch. Power steering pressure switch is located near driver's side front corner of engine compartment, near strut tower and contains a Dark Gray 2-pin electrical connector with Green and White/Black wires.

Sub-Throttle Position Sensor (Supra Turbo)

Sub-throttle position sensor is located on throttle body. Sub-throttle position sensor delivers an input signal to indicate throttle valve position to Engine Control Module (ECM) and throttle control Electronic Control Unit (ECU) for controlling the traction control system.

Throttle Position (TP) Sensor (Avalon, Camry, Celica, Corolla, RAV4, Sienna, Supra Turbo, Tacoma, Tercel, T100 & 4Runner)

The TP sensor is located on the throttle body. TP sensor delivers an input signal indicating throttle position to the Engine Control Module (ECM). The ECM may use input signal for determining ignition timing (spark advance) and for controlling fuel injection system, idle speed control system and various other systems.

Throttle Position (TP) Sensor (Land Cruiser, LX470 & Supra Non - Turbo)

The TP sensor is used with the Electronic Throttle Control System (ETCS) for controlling of the throttle operation. See ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) under AIR INDUCTION SYSTEM for additional information.

Turbo Pressure Sensor (Supra Turbo)

Turbo pressure sensor delivers an input signal to Engine Control Module (ECM), indicating turbo boost pressure. The ECM uses input signal for controlling turbo boost pressure.

NOTE: Vapor pressure sensor may also referred to as EVAP vapor pressure sensor. Vapor pressure sensor VSV may also be referred to as EVAP Vapor Pressure Sensor Vacuum Switching Valve (EVAP-VPSVSV).

Vapor Pressure Sensor (Avalon, Camry, Celica Calif. Emission Vehicles, Corolla, Land Cruiser, LX470, RAV4, Sienna, Supra Non - Turbo, Tacoma, Tercel, T100 & 4Runner)

The Engine Control Module (ECM) monitors fuel tank pressure to determine if a leak or an abnormality exists in the EVAP system. A vapor pressure sensor Vacuum Switching Valve (VSV) is located in the vapor line to the charcoal canister. The ECM will operate the VSV, allowing vapor pressure sensor to monitor the fuel tank pressure and EVAP system. Vapor pressure sensor delivers an input signal to ECM to indicate fuel tank pressure.

Vehicle Speed Sensor (Avalon, Camry, Celica, Corolla, Land Cruiser, RAV4, Supra Turbo, Tacoma 2.7L 4-Cyl. 3RZ-FE & 4Runner 2.7L 4-Cyl.)

Vehicle speed sensor is mounted on transmission/transaxle. Vehicle speed sensor monitors vehicle speed and delivers an input signal to instrument cluster where the input signal is converted to a rectangular waveform and then sent to the Engine Control Module (ECM). The ECM determines vehicle speed by using input signal and may use input signal for controlling fuel injection system and electronically controlled automatic transmission/transaxle (if equipped).

Vehicle Speed Sensor (Sienna, Tacoma 3.4L V6 & 4Runner 3.4L V6)

Wheel speed sensors on each wheel deliver an input signal to the Anti-Lock Brake System (ABS) Electronic Control Unit (ECU). The ABS ECU converts input signals from wheel speed sensors to a 4-pulse input signal to the instrument cluster. The instrument cluster then converts the 4-pulse input signal to a rectangular waveform and then sends the input signal to the Engine Control Module (ECM). The ECM determines the vehicle speed by using the input signal. The ECM uses input signal for controlling fuel injection system and electronic control of automatic transmission/transaxle.

Vehicle Speed Sensor (Supra Non-Turbo)

Vehicle speed sensor is mounted on transmission. Vehicle speed sensor may also be referred to as vehicle speed sensor No. 2.

Vehicle speed sensor monitors vehicle speed and delivers an input signal to SP2+ and SP2- terminals of Engine Control Module (ECM). The ECM determines vehicle speed by using input signal and may use input signal for controlling fuel injection system and electronically controlled automatic transmission (if equipped).

Vehicle Speed Sensor (Tacoma 2.4L 2RZ-FE 4-Cyl., Tercel & T100)

Vehicle speed sensor is a reed switch mounted on rear of instrument cluster and rotates with the speedometer cable. With each rotation of speedometer cable, vehicle speed sensor turns on and off 4 times and delivers an input signal to Engine Control Module (ECM). The ECM determines vehicle speed by using the input signal and may use input signal for controlling fuel injection system and electronically controlled automatic transmission (if equipped).

4WD Switch (Tacoma, T100 & 4Runner)

On 4WD models, 4WD switch on transfer case delivers an input signal to 4WD terminal of Engine Control Module (ECM) to indicate 4WD operation.

OUTPUT SIGNALS

NOTE: Vehicles are equipped with different combinations of computer-controlled components. Not all components listed below are used on every vehicle. For theory and operation on each output component, refer to system indicated after component.

The Engine Control Module (ECM) receives input from data sensors and switches, depending on model application, to control following components and sub-systems:

Accelerator Pedal Position Sensor

See ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) under AIR INDUCTION SYSTEM.

A/C-Cut Control System

See IDLE SPEED under FUEL SYSTEM.

Circuit Opening Relay

See FUEL DELIVERY under FUEL SYSTEM.

EGR Vacuum Switching Valve (VSV)

See EXHAUST GAS RECIRCULATION (EGR) SYSTEM under EMISSION SYSTEMS.

Electronically Controlled Transmission/Transaxle

See TRANSMISSION/TRANSAXLE CONTROLS under MISCELLANEOUS CONTROLS.

Electronic Spark Advance System

See DISTRIBUTORLESS IGNITION SYSTEM and DISTRIBUTOR TYPE IGNITION SYSTEM under IGNITION SYSTEM.

EVAP Vacuum Switching Valve (VSV)

See EVAPORATIVE EMISSION (EVAP) SYSTEM under EMISSION SYSTEMS.

Exhaust By-Pass Valve Vacuum Switching Valve (VSV)

See TURBOCHARGERS under AIR INDUCTION SYSTEM.

Exhaust Gas Control Valve Vacuum Switching Valve (VSV)

See TURBOCHARGERS under AIR INDUCTION SYSTEM.

Fuel Pressure Control System Vacuum Switching Valve (VSV)
See FUEL DELIVERY under FUEL SYSTEM.

Fuel Pump
See FUEL DELIVERY under FUEL SYSTEM.

Idle Speed Control System
See IDLE SPEED under FUEL SYSTEM.

Intake Air Control Valve System
See INTAKE AIR CONTROL VALVE SYSTEM under AIR INDUCTION
SYSTEM.

Self-Diagnostic System
See SELF-DIAGNOSTIC SYSTEM.

Throttle Control Motor
See ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) under AIR
INDUCTION SYSTEM.

Throttle Control Motor
See ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) under AIR
INDUCTION SYSTEM.

Vapor Pressure Sensor Vacuum Switching Valve (EVAP-VPSVSV)
See EVAPORATIVE EMISSION (EVAP) SYSTEM under EMISSION
SYSTEMS.

Wastegate Vacuum Switching Valve (VSV)
See TURBOCHARGERS under AIR INDUCTION SYSTEM.

FUEL SYSTEM

FUEL DELIVERY

Vehicles are equipped with different combinations of fuel system electrical components. For complete wiring circuit of electrical components on a specific model, see appropriate wiring diagram in L - WIRING DIAGRAMS article.

NOTE: Circuit opening relay is used on all models except Land Cruiser and Supra. Circuit opening relay may be identified by appropriate illustration in appropriate see I - SYSTEM/COMPONENT TESTING article.

Circuit Opening Relay (Avalon, Camry & Corolla)

Circuit opening relay controls the fuel pump circuit. When EFI main relay is energized, EFI main relay provides battery voltage to circuit opening relay. When proper input signals are delivered to the Engine Control Module (ECM), the circuit opening relay ground circuit is grounded at ECM terminal FC. Circuit opening relay then provides voltage to fuel pump for fuel pump operation. For circuit opening relay location, see CIRCUIT OPENING RELAY LOCATION table.

Circuit Opening Relay (Celica)

Circuit opening relay controls the fuel pump circuit. When EFI main relay is energized, EFI main relay provides battery voltage to one side of circuit opening relay. When engine is cranking, circuit opening relay receives a start signal which energizes circuit opening relay. Circuit opening relay then provides voltage to fuel pump for

fuel pump operation. When start signal is released from circuit opening relay, the Engine Control Module (ECM) then controls the ground circuit for circuit opening relay at ECM terminal FC. Circuit opening relay then provides voltage to fuel pump for fuel pump operation. For circuit opening relay location, see CIRCUIT OPENING RELAY LOCATION table.

Circuit Opening Relay (RAV4)

Circuit opening relay controls fuel pump circuit. When EFI main relay is energized, EFI main relay provides battery voltage to one side of circuit opening relay. When ignition is turned on, voltage is supplied to the other side of circuit opening relay. When proper input signals are delivered to the Engine Control Module (ECM), the circuit opening relay ground circuit is grounded at ECM terminal FC. Circuit opening relay then provides voltage to fuel pump for fuel pump operation. For circuit opening relay location, see CIRCUIT OPENING RELAY LOCATION table.

Circuit Opening Relay (Sienna)

Circuit opening relay controls the fuel pump circuit. When EFI main relay is energized, EFI main relay provides battery voltage to circuit opening relay. When proper input signals are delivered to the Engine Control Module (ECM), the circuit opening relay ground circuit is grounded at ECM terminal FC. Circuit opening relay then provides voltage to fuel pump for fuel pump operation. For circuit opening relay location, see CIRCUIT OPENING RELAY LOCATION table.

Circuit Opening Relay (Tacoma & T100)

Circuit opening relay controls the fuel pump circuit. When EFI main relay is energized, EFI main relay provides battery voltage to one side of circuit opening relay. When engine is cranking, circuit opening relay receives a start signal which energizes circuit opening relay. Circuit opening relay then provides voltage to fuel pump for fuel pump operation. When start signal is released from circuit opening relay, the Engine Control Module (ECM) then controls the ground circuit for circuit opening relay at ECM terminal FC. Circuit opening relay then provides voltage to fuel pump for fuel pump operation. For circuit opening relay location, see CIRCUIT OPENING RELAY LOCATION table.

Circuit Opening Relay (Tercel)

Circuit opening relay controls the fuel pump circuit. When EFI main relay is energized, EFI main relay provides battery voltage to circuit opening relay. When proper input signals are delivered to the Engine Control Module (ECM), the circuit opening relay ground circuit is grounded at ECM terminal FC. Circuit opening relay then provides voltage to fuel pump for fuel pump operation. For circuit opening relay location, see CIRCUIT OPENING RELAY LOCATION table.

Circuit Opening Relay (4Runner)

Circuit opening relay controls the fuel pump circuit. When EFI main relay is energized, EFI main relay provides battery voltage to circuit opening relay. When proper input signals are delivered to the Engine Control Module (ECM), the circuit opening relay ground circuit is grounded at ECM terminal FC. Circuit opening relay then provides voltage to fuel pump for fuel pump operation. For circuit opening relay location, see CIRCUIT OPENING RELAY LOCATION table.

CIRCUIT OPENING RELAY LOCATION TABLE

| Application | Location |
|--------------|---|
| Avalon | (1) Top Rear Corner Of Relay Box Behind |

| | |
|---------------|--|
| | Passenger's Side Kick Panel |
| Camry | (1) In Relay Box At Driver's Side Front Corner Of Engine Compartment, Near Battery & Air Cleaner |
| Celica | Below Passenger's Side Of Instrument Panel, Underneath Carpet, Near Center Console, Attached To Rear Of ECM |
| Corolla | Center Relay In Relay Box, Behind Driver's Side Kick Panel |
| RAV4 | Top Rear Relay In Relay Box Below Driver's Side Of Instrument Panel, Behind Kick Panel |
| Sienna | (1) In Relay Box At Driver's Side Front Corner Of Engine Compartment, Near Battery & Air Cleaner |
| Tacoma | Behind Lower Instrument Panel Cover, Next To Driver's Side Of Steering Column |
| Tercel | Near Top Right Corner Of Fuse/Relay Box Behind Driver's Side Lower Instrument Panel Cover, Near Steering Column |
| T100 | Behind Glove Box, Near Passenger's Side Kick Panel |
| 4Runner | Below Right Corner Of Fuse/Relay Box Behind Lower Instrument Panel Cover At Driver's Side Of Instrument Panel To Left Of Steering Column, Just Above Hood Release Lever |

(1) - Circuit opening relay may be marked as CIR OPN relay in the relay box.

NOTE: EFI main relay may also be referred to as EFI relay.

EFI Main Relay (Avalon & Camry)

The EFI fuse supplies constant battery voltage to EFI main relay. EFI main relay may be energized when ignition is turned on by voltage supplied through IGN fuse to EFI main relay, or by MREL terminal of Engine Control Module (ECM) depending on vehicle application. See appropriate wiring diagram in L - WIRING DIAGRAMS article. When EFI main relay is energized, the EFI main relay provides battery voltage to circuit opening relay, data link connector No. 1 and various other electrical components. The EFI main relay also provides battery voltage to +B terminal of ECM. For EFI main relay location, see EFI MAIN RELAY LOCATION table.

EFI Main Relay (Celica)

The EFI fuse supplies constant battery voltage to EFI main relay. When ignition is turned on, voltage is supplied through IGN fuse to EFI main relay. EFI main relay is then energized and provides battery voltage to circuit opening relay, data link connector No. 1 and various other electrical components. The EFI main relay also provides battery voltage to +B terminal of Engine Control Module (ECM) when ignition is turned on. For EFI main relay location, see EFI MAIN RELAY LOCATION table.

EFI Main Relay (Corolla)

The EFI fuse supplies constant battery voltage to EFI main relay. EFI fuse may also be referred to as F-HTR fuse. EFI main relay may also be referred to as EFI relay or F-HTR relay. When ignition is turned on, voltage is supplied through IGN fuse to EFI main relay. EFI main relay is then energized and provides battery voltage to circuit opening relay, data link connector No. 1 and various other electrical components. The EFI main relay also provides battery voltage to +B terminal of Engine Control Module (ECM) when ignition is turned on.

For EFI main relay location, see EFI MAIN RELAY LOCATION table.

EFI Main Relay (Land Cruiser & LX470)

The EFI fuse supplies constant battery voltage to EFI main relay. When EFI main relay is energized by MREL terminal of Engine Control Module (ECM), the EFI main relay provides battery voltage to +B terminal of fuel pump Electronic Control Unit (ECU) and various other electrical components. The EFI main relay also provides battery voltage to +B terminal of ECM. For operation of fuel pump ECU and fuel pump switch, see FUEL PUMP ELECTRONIC CONTROL UNIT (ECU) & FUEL PUMP SWITCH under FUEL PUMP CONTROL CIRCUIT. For EFI main relay location, see EFI MAIN RELAY LOCATION table.

EFI Main Relay (RAV4)

The EFI fuse supplies constant battery voltage to EFI main relay. When ignition is turned on, voltage is supplied to EFI main relay from the ignition switch. EFI main relay is then energized and provides battery voltage to circuit opening relay, data link connector No. 1 and various other electrical components. The EFI main relay also provides battery voltage to +B terminal of Engine Control Module (ECM) when ignition is turned on. For EFI main relay location, see EFI MAIN RELAY LOCATION table.

EFI Main Relay (Sienna, Tacoma, Tercel, T100 & 4Runner)

The EFI fuse supplies constant battery voltage to EFI main relay. When ignition is turned on, voltage is supplied through IGN fuse to EFI main relay. EFI main relay is then energized and provides battery voltage to circuit opening relay, data link connector No. 1 and various other electrical components. The EFI main relay also provides battery voltage to +B terminal of Engine Control Module (ECM) when ignition is turned on. For EFI main relay location, see EFI MAIN RELAY LOCATION table.

EFI Main Relay (Supra Non-Turbo)

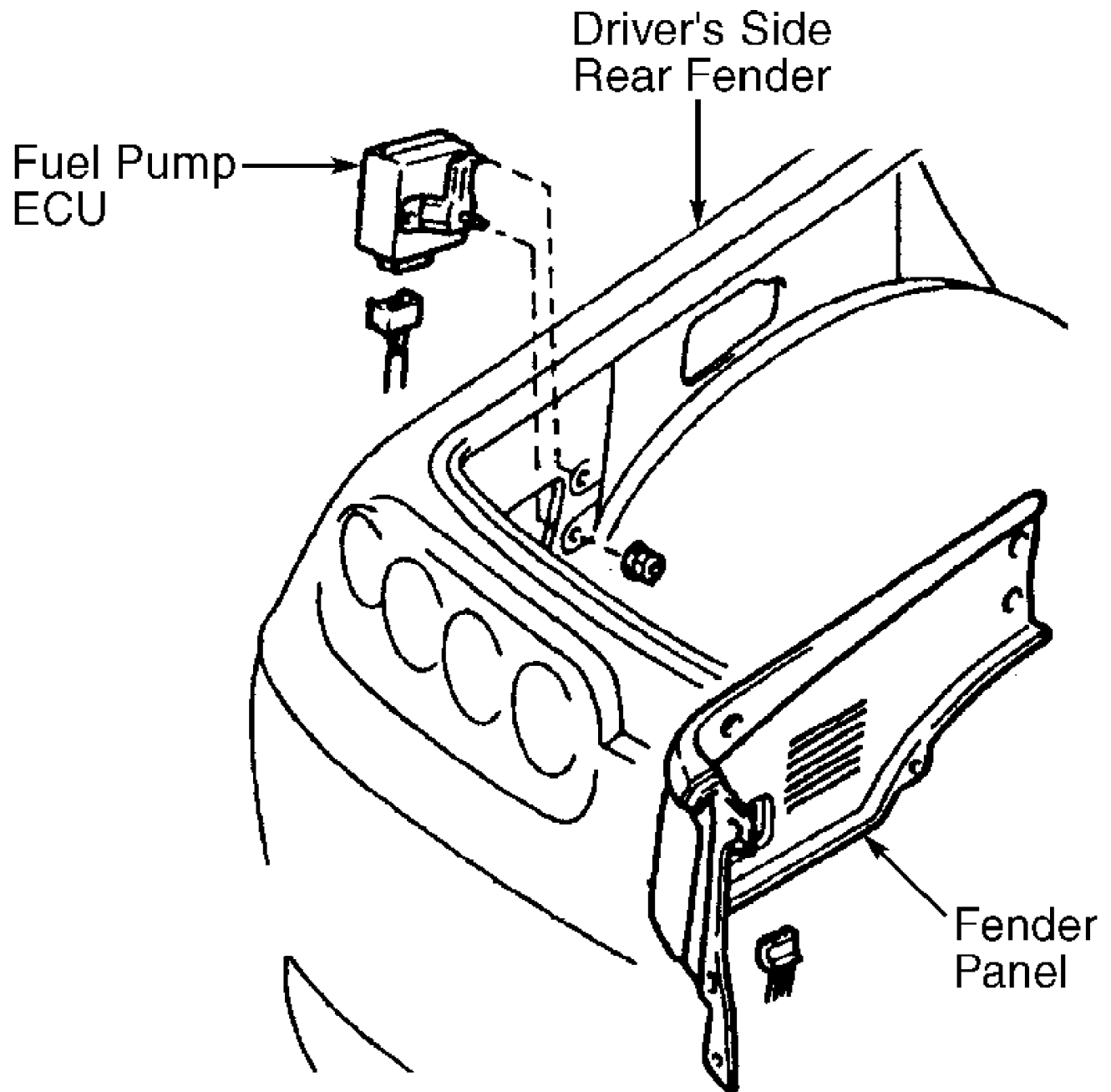
The EFI No. 1 fuse (30-amp) supplies constant battery voltage to EFI main relay. EFI No. 1 fuse and EFI main relay are located in fuse/relay box at driver's side front corner of engine compartment, near the battery. The EFI main relay is turned on by M-REL terminal of Engine Control Module (ECM). When EFI main relay is turned on, voltage is supplied to +B and +B2 terminals of ECM, data link connector No. 1, +B terminal of fuel pump Electronic Control Unit (ECU) and various other electrical components. Fuel pump ECU is located in driver's side rear corner of trunk. See Fig. 26. Fuel pump operating speed is controlled by the operating condition of the engine such as: starting, light load or heavy load. The ECM delivers an input signal from FPC terminal on ECM to FPC terminal on fuel pump ECU in accordance with the engine operating condition. The fuel pump ECU uses this input signal to determine how much voltage should be delivered to the fuel pump for varying fuel pump operating speed.

EFI Main Relay & EFI No. 2 Relay (Supra Turbo)

The EFI No. 1 fuse (30-amp) supplies constant battery voltage to EFI main relay. The EFI main relay is turned on by M-REL terminal of Engine Control Module (ECM). When EFI main relay is turned on, voltage is supplied to EFI No. 2 relay, +B terminal of ECM, data link connector No. 1 and various other electrical components. EFI No. 1 fuse, EFI main relay and EFI No. 2 relay are located in fuse/relay box at driver's side front corner of engine compartment, near the battery.

EFI No. 2 fuse (30-amp) supplies constant battery voltage to EFI No. 2 relay. When EFI No. 2 relay is energized by voltage supplied from EFI main relay, relay closes and voltage is provided to +B terminal on fuel pump Electronic Control Unit (ECU). Fuel pump ECU is located in driver's side rear corner of trunk. See Fig. 26. Fuel pump

operating speed is controlled by the operating condition of the engine such as: starting, light load or heavy load. The ECM delivers an input signal from FPC terminal on ECM to FPC terminal on fuel pump ECU in accordance with the engine operating condition. The fuel pump ECU uses this input signal to determine how much voltage should be delivered to the fuel pump for varying fuel pump operating speed.



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Fig. 26: Locating Typical Fuel Pump ECU (Supra)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

| Application | Location |
|---|--|
| Avalon, Camry & Celica | In Fuse/Relay Box At Driver's Side Front Corner Of Engine Compartment, Near Battery |
| Corolla | In Fuse/Relay Box At Driver's Side Front Corner Of Engine Compartment, Near Strut Tower |
| Land Cruiser & LX470 | In Fuse/Relay Box At Driver's Side Front Corner Of Engine Compartment, Near Battery |
| RAV4 | In Fuse/Relay Box Behind Driver's Side Of Instrument Panel, Next To Steering Column |
| Sienna, Tacoma, T100 & 4Runner | In Fuse/Relay Box At Driver's Side Front Corner Of Engine Compartment, Near Battery |
| Tercel | In Fuse/Relay Box At Driver's Side Front Corner Of Engine Compartment, Near Strut Tower |

Fuel Pump (Avalon, Camry, Celica, Corolla, RAV4, Sienna, Tacoma, Tercel, T100 & 4Runner)

Electric fuel pump is mounted in the fuel tank. Fuel pump operates at one specified speed.

Fuel Pump (Land Cruiser & LX470)

Electric fuel pump is mounted in the fuel tank. Fuel pump operating speed is varied by use of fuel pump Electronic Control Unit (ECU). For additional information, see FUEL PUMP ELECTRONIC CONTROL UNIT (ECU) & FUEL PUMP SWITCH under FUEL SYSTEM.

Fuel Pump (Supra)

Electric fuel pump is mounted in the fuel tank. Fuel pump operating speed is varied by use of fuel pump Electronic Control Unit (ECU). For additional information, see EFI MAIN RELAY under FUEL SYSTEM for non-turbo models, or EFI MAIN RELAY & EFI NO. 2 RELAY under FUEL SYSTEM for turbo models.

Fuel Pump Electronic Control Unit (ECU) & Fuel Pump Switch (Land Cruiser & LX470)

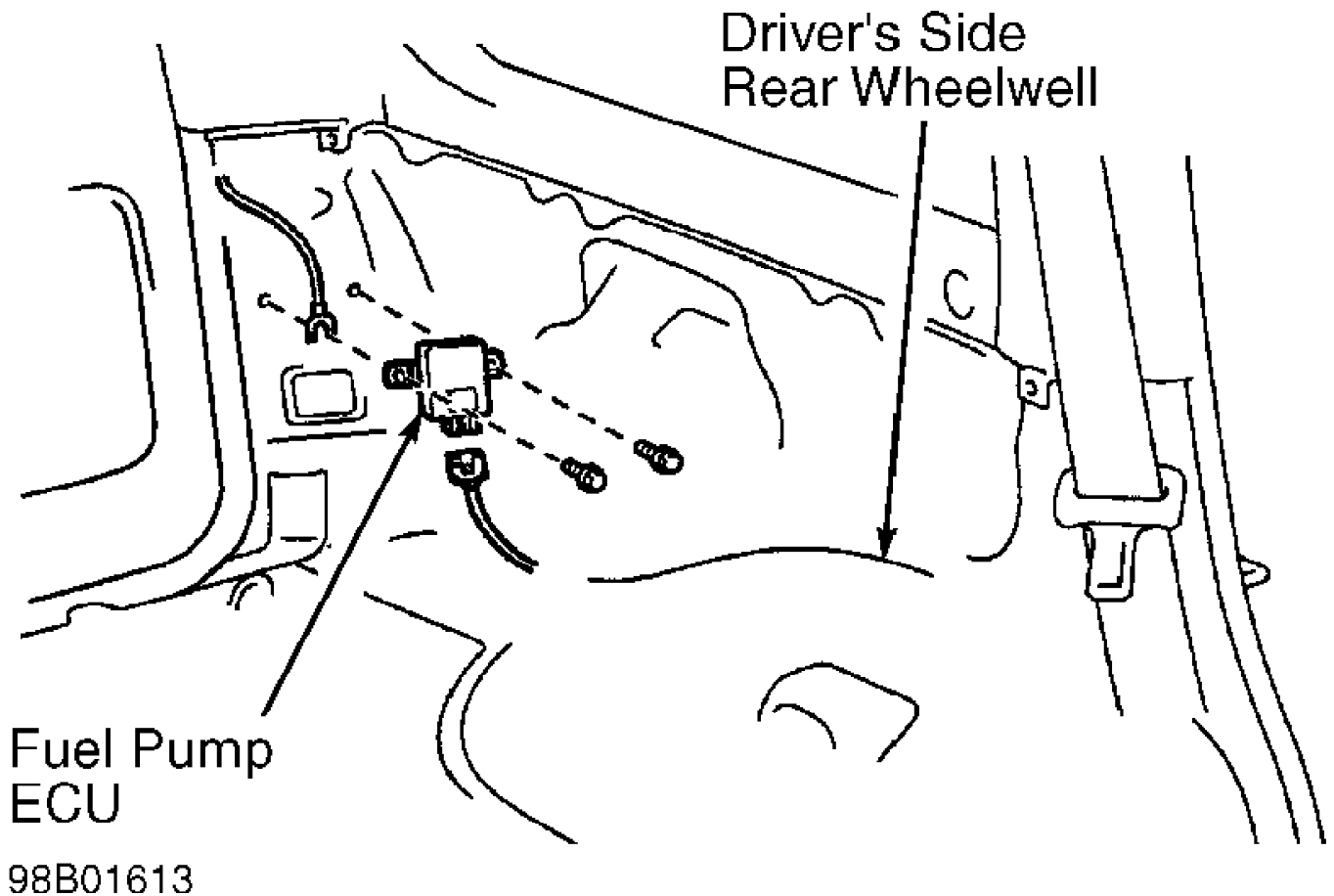
Fuel pump operating speed is controlled by the operating condition of the engine such as: starting, idling, light load or heavy load. The Engine Control Module (ECM) delivers an input signal from FPC terminal on ECM to FPC terminal on fuel pump ECU in accordance with the engine operating condition. The fuel pump ECU uses this input signal to determine how much voltage should be delivered to the fuel pump for varying fuel pump operating speed. If a problem exists in fuel pump ECU or control circuit, Diagnostic Trouble Code (DTC) P1200 may be stored in the ECM. See appropriate G - TESTS W/CODES article for retrieving and servicing of any DTCs. Fuel pump ECU is located behind inner panel, just behind driver's rear wheelwell. See Fig. 27.

NOTE: Fuel pump switch may also be referred to as fuel pump inertia switch or fuel pump control switch.

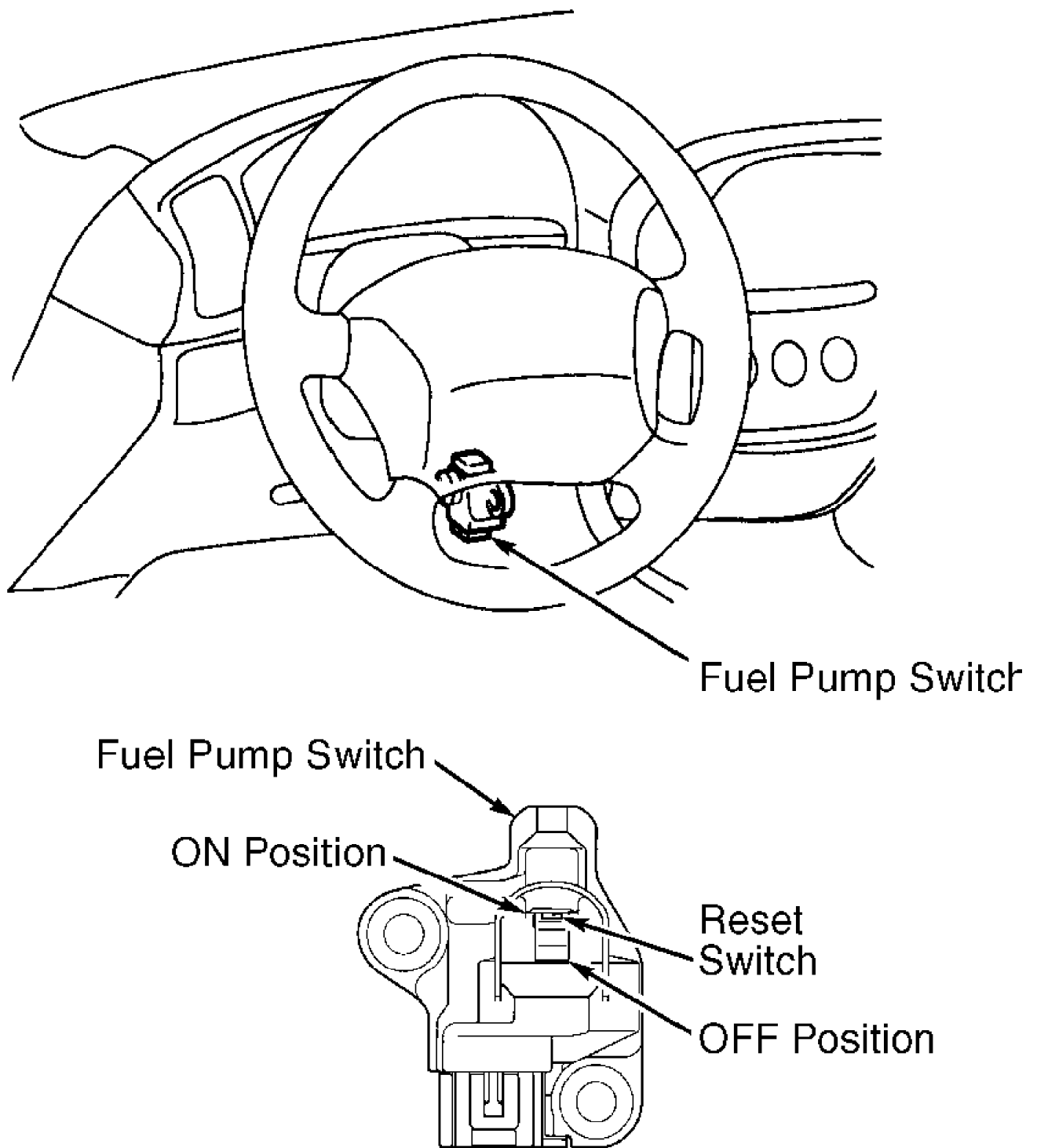
The fuel pump switch is in the circuit between FPC terminal on ECM and FPC terminal on fuel pump ECU. If the vehicle is involved in a collision, the fuel pump switch will shut off the fuel pump by opening this circuit, and not allowing any input signal to be delivered from ECM to fuel pump ECU. Fuel pump switch is located on driver's side of instrument panel. See Fig. 28. Fuel pump switch contains a reset switch which has an OFF and ON position. See Fig. 28. Continuity will exist between electrical terminals on fuel pump switch with reset switch in the ON position, and no continuity in the OFF position. Reset switch must be in ON position for fuel pump operation.

Fuel Pump Electronic Control Unit (ECU) (Supra)

Fuel pump ECU is located in driver's side rear corner of trunk. See Fig. 26. Fuel pump operating speed is controlled by the operating condition of the engine such as: starting, light load or heavy load. The ECM delivers an input signal from FPC terminal on ECM to FPC terminal on fuel pump ECU in accordance with the engine operating condition. The fuel pump ECU uses this input signal to determine how much voltage should be delivered to the fuel pump for varying fuel pump operating speed.



98B01613
Fig. 27: Locating Fuel Pump ECU (Land Cruiser & LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



98J01612

Fig. 28: Locating Fuel Pump Switch & Identifying Reset Switch Positions (Land Cruiser & LX470)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Fuel Pressure Regulator (Avalon, Camry, Corolla, RAV4,

Sienna, Supra Non-Turbo & Tercel)

Fuel system is a returnless fuel system with fuel pressure regulator mounted on the fuel pump in the fuel tank. Fuel pressure regulator maintains constant fuel pressure to the fuel injectors.

Fuel Pressure Regulator (Celica, Land Cruiser, LX470, Supra Turbo, Tacoma, T100 & 4Runner)

Mounted on fuel rail, vacuum-operated fuel pressure regulator maintains constant fuel pressure to fuel injectors. As throttle is depressed and manifold vacuum decreases, fuel pressure regulator increases fuel pressure to maintain a constant fuel flow to fuel injectors.

NOTE: Fuel pressure control system may also be referred to as fuel pressure-up system.

Fuel Pressure Control System & Vacuum Switching Valve (VSV)
(Supra Turbo)

Fuel pressure control system increases fuel pressure slightly on hot restarts for improved starting and idle stability. Fuel pressure increase is obtained by shutting off vacuum supply to fuel pressure regulator. The Engine Control Module (ECM) controls vacuum supply to fuel pressure regulator by operating fuel pressure control VSV. Increased fuel pressure will exist for approximately 90-180 seconds after hot restart. Fuel pressure control VSV is located near throttle body on intake manifold.

FUEL CONTROL

Fuel-Cut System (All Models)

Controlled through input signals, the Engine Control Module (ECM) will shut off fuel delivery momentarily during closed throttle deceleration.

Fuel Injectors (All Models)

Fuel injectors are electrically operated solenoids which deliver fuel to individual cylinders. The Engine Control Module (ECM) controls fuel injector duration based on various input signals to determine air/fuel mixture.

NOTE: Solenoid resistor may also be referred to as fuel injector resistor or SFI resistor.

Solenoid Resistor (Supra Turbo)

Solenoid resistor reduces current flow to fuel injectors. Solenoid resistor is mounted on top of the driver's side front strut tower.

IDLE SPEED

A/C-Cut Control System (Camry, Celica, Corolla, Land Cruiser, LX470, RAV4, Supra & Tercel)

The Engine Control Module (ECM) uses various input signals for controlling A/C-cut control system. The A/C-cut control system interrupts A/C compressor operation for a fixed period of time when vehicle accelerates from low engine speed.

Dashpot (Supra Turbo, Tacoma 3.4L V6 With M/T, T100 3.4L V6 With M/T & 4Runner 3.4L V6 With M/T)

Dashpot is mounted on throttle body and is used to allow engine to slowly return to specified RPM after throttle is released.

NOTE: Idle speed control system may also be referred to as idle

air control system.

Idle Speed Control System (Avalon, Camry, Celica, Corolla, RAV4, Sienna, Supra Turbo, Tacoma, Tercel, T100 & 4Runner)

Engine Control Module (ECM) is programmed with engine idle speed values. Idle speed control system provides a stable idle speed when engine is cold or idle speed decreases due to electrical load. The ECM uses various input signals to maintain proper idle speed by controlling Idle Air Control (IAC) valve.

Throttle Control Motor (Land Cruiser, LX470 & Supra Non-Turbo)

Throttle control motor is used with the ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) for controlling of the throttle operation and idle speed. See ELECTRONIC THROTTLE CONTROL SYSTEM (ETCS) under AIR INDUCTION SYSTEM for additional information.

Throttle Opener (Avalon, Camry, Celica, RAV4, Sienna, Supra Turbo, Tacoma, T100 & 4Runner)

Throttle opener, mounted on throttle body, is vacuum controlled and allows engine to return to specified RPM after throttle is released.

IGNITION SYSTEM

DISTRIBUTORLESS IGNITION SYSTEM

NOTE: The distributorless ignition system may be referred to as Electronic Spark Advance (ESA) system.

Avalon, Camry 3.0L V6 & Sienna

Distributorless Ignition System (DIS) uses the Engine Control Module (ECM) for determining ignition timing (spark advance). The ECM may determine ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signals.

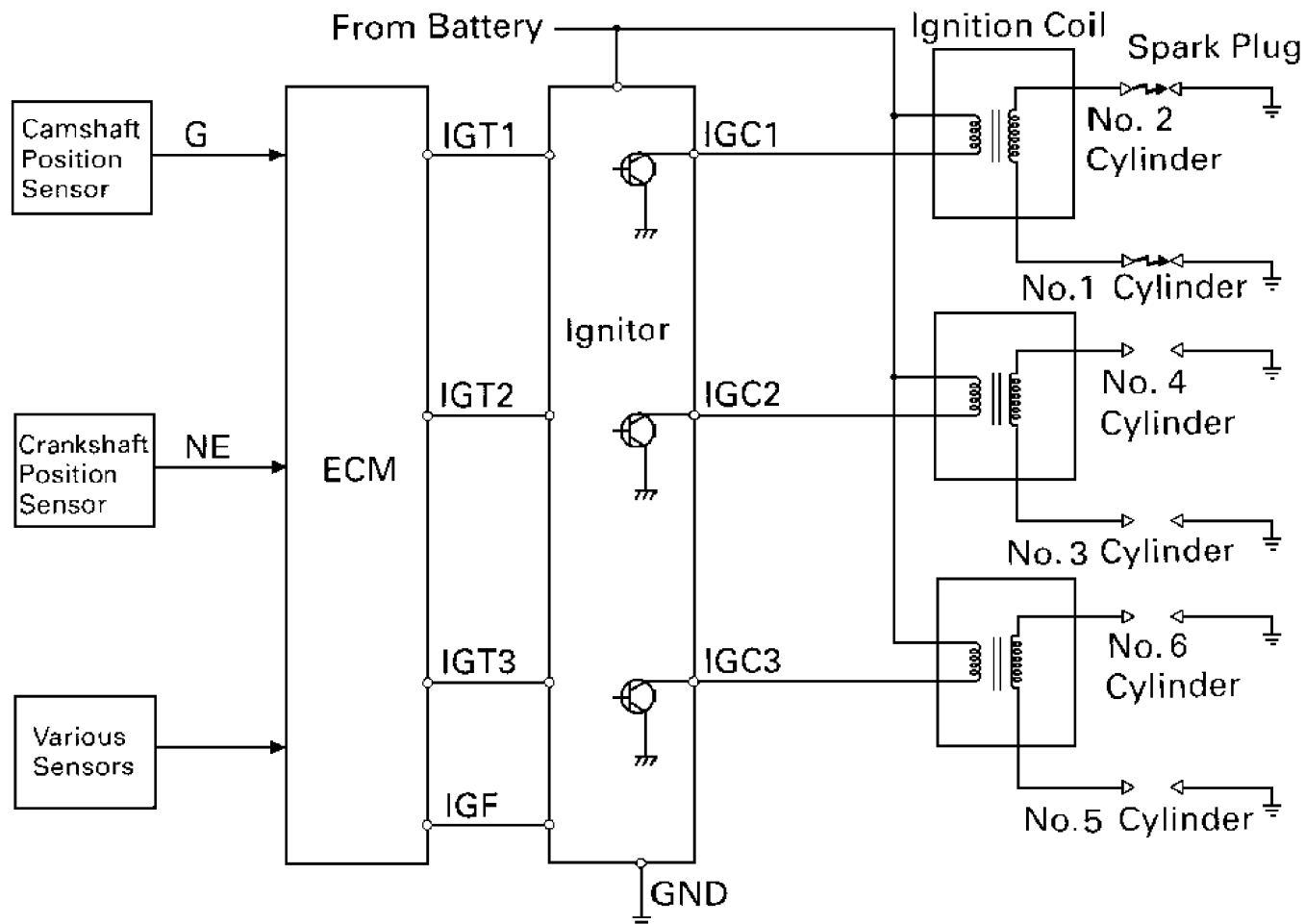
NOTE: Camshaft position sensor may also be referred to as cam position sensor.

Conventional distributor and pick-up coil have been replaced by a camshaft position sensor and crankshaft position sensor. Camshaft position sensor and crankshaft position sensor deliver input signals to ECM. The ECM detects the standard crankshaft position based on camshaft position sensor input signals, and the actual crankshaft position and engine speed by the crankshaft position sensor input signals. Camshaft position sensor is located at flywheel end of front cylinder head, just below valve cover. See Figs. 7-10 and 13-14. Crankshaft position sensor is located at front of crankshaft, near crankshaft pulley. See Figs. 7-10 and 13-14. For knock sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

The ECM uses 3 ignition primary control signals to the ignitor for the ignition coils. The DIS uses 3 ignition coils which fire 2 cylinders simultaneously using the same ignition coil. See Fig. 29. Cylinder No. 1 is front cylinder on right side of engine when viewed from flywheel end of engine. Cylinder No. 2 is front cylinder on left side of engine when viewed from flywheel end of engine. Cylinders No. 1, 3 and 5 are on right side of engine. Cylinders No. 2, 4 and 6 are on left side of engine.

One ignition coil is mounted on top of spark plug on cylinders No. 2, 4 and 6. Spark plug wires are routed from ignition coils on top of spark plugs to the spark plugs on the remaining cylinders. The ECM monitors IGF circuit at the ignitor to ensure

ignition coils have fired.



97E06297

Fig. 29: Distributorless Ignition System Schematic (Avalon, Camry 3.0L V6 & Sienna)

Courtesy of Toyota Motor Sales, U.S.A., Inc.

Camry 2.2L 4-Cyl., Corolla & RAV4

Distributorless Ignition System (DIS) uses the Engine Control Module (ECM) for determining ignition timing (spark advance). The ECM may determine ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signal.

NOTE: Camshaft position sensor may also be referred to as cam position sensor.

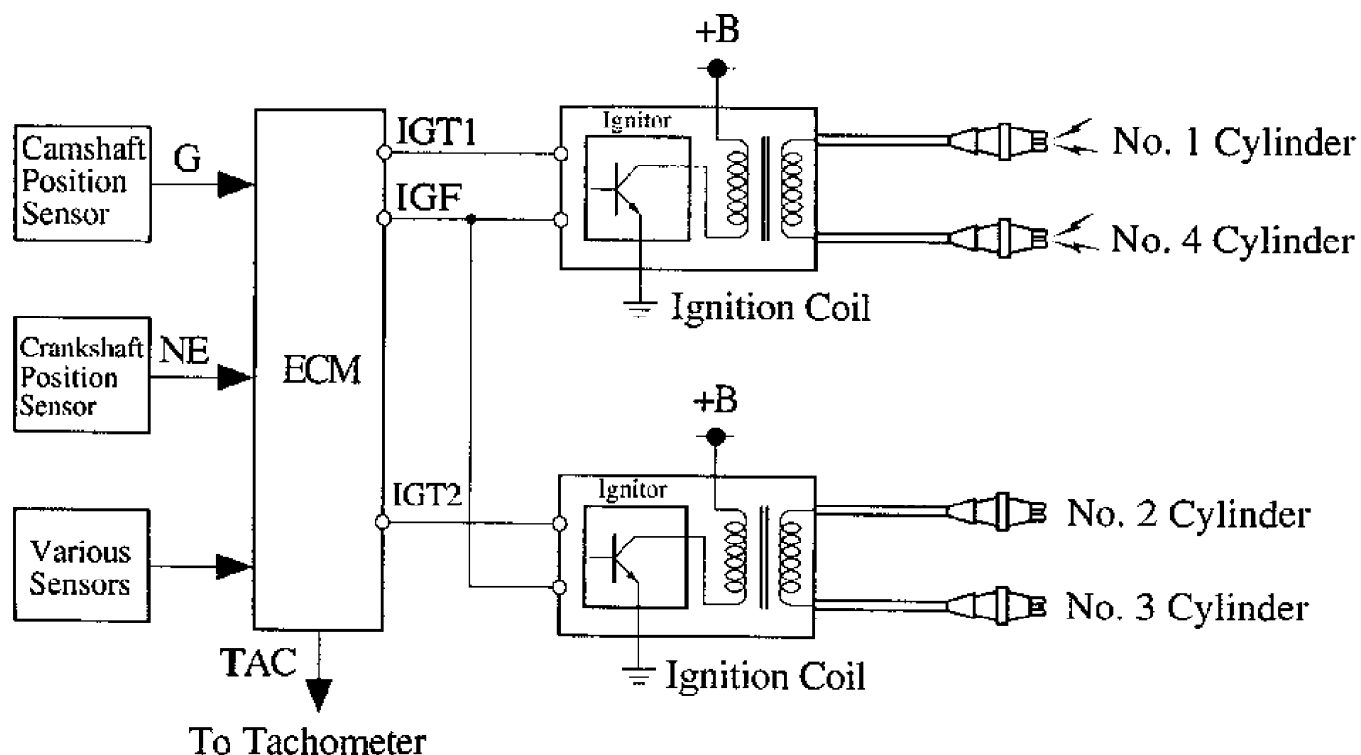
Conventional distributor and pick-up coil have been replaced by a camshaft position sensor and crankshaft position sensor. Camshaft position sensor and crankshaft position sensor deliver input signals to ECM. ECM detects the standard crankshaft position based on camshaft position sensor input signals, and the actual crankshaft position and engine speed by the crankshaft position sensor input signals.

On Camry 2.4L 4-cylinder and RAV4, camshaft position sensor is located at timing belt end of cylinder head, on the firewall side of the engine. See Figs. 7-8 and 13-14. Crankshaft position sensor is located at timing belt end of engine, behind timing belt cover, near

sprocket on crankshaft. See Figs. 7-8 and 13-14. For knock sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

On Corolla, camshaft position sensor is located just above the intake manifold on cylinder head, at flywheel end of engine. See Figs. 11-12. Crankshaft position sensor is located on front of engine, near crankshaft pulley. See Figs. 11-12. For knock sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

On all models, the ECM uses 2 ignition primary control signals to the ignitor on for the ignition coils. The DIS uses 2 ignition coils with internal ignitors to fire 2 cylinders simultaneously using the same ignition coil. See Fig. 30. Cylinders No. 1 and 4 fire together and cylinders No. 2 and 3 fire together. Cylinder No. 1 is front cylinder at timing belt or timing chain end of engine and cylinder No. 4 is the rear cylinder at flywheel end of engine. Ignition coils are mounted on end of cylinder head, just below the valve cover. The ECM monitors IGF circuit at the ignitor to ensure ignition coils have fired. ECM stops fuel injection as a fail-safe function if IGF signal if ECM does not receive IGF signal.



97C06296

Fig. 30: Typical Distributorless Ignition System Schematic (Camry 2.2L 4-Cyl., Corolla, RAV4, Tacoma 2.4L 4-Cyl. & 2.7L 4-Cyl., T100 2.7L 4-Cyl. & 4Runner 2.7L 4-Cyl.)

Courtesy of Toyota Motor Sales, U.S.A., Inc.

Land Cruiser & LX470

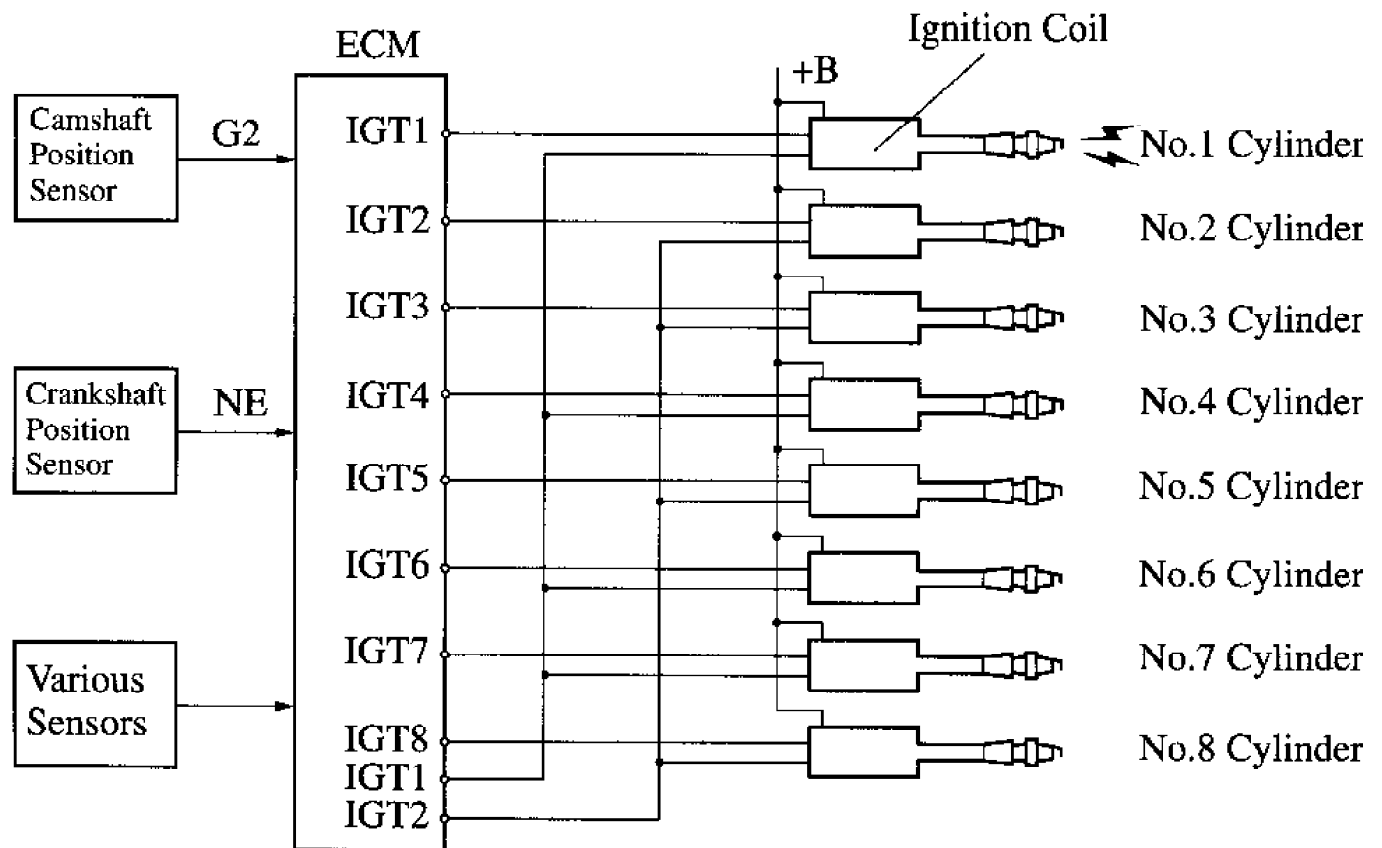
Distributorless Ignition System (DIS) uses the Engine Control Module (ECM) for determining ignition timing (spark advance). The ECM may determine ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signals.

NOTE: Camshaft position sensor may also be referred to as cam position sensor.

Conventional distributor and pick-up coil have been replaced by a camshaft position sensor and crankshaft position sensor. Camshaft position sensor and crankshaft position sensor deliver input signals to ECM. The ECM detects the standard crankshaft position based on camshaft position sensor input signals, and the actual crankshaft position and engine speed by the crankshaft position sensor input signals. Camshaft position sensor is located behind driver's side upper timing belt cover, near camshaft sprocket. See Figs. 11-12. Crankshaft position sensor is located at front of crankshaft, near crankshaft pulley. See Figs. 11-12. For knock sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

The ECM uses 8 ignition primary control signals to the ignitors for the ignition coils. The DIS uses 8 ignition coils with internal ignitors, one ignition coil for each cylinder. See Fig. 31. Cylinder No. 1 is front cylinder on left side of engine when viewed from flywheel end of engine. Cylinder No. 2 is front cylinder on right side of engine when viewed from flywheel end of engine. Cylinders No. 1, 3, 5 and 7 are on left side of engine. Cylinders No. 2, 4, 6 and 8 are on right side of engine.

The ECM monitors IGF circuit at the ignitor to ensure ignition coils have fired. The ECM stops fuel injection as a fail-safe function if IGF signal if ECM does not receive the IGF signal.



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Fig. 31: Distributorless Ignition System (Land Cruiser & LX470)

Schematic

Courtesy of Toyota Motor Sales, U.S.A., Inc.

Supra Non-Turbo

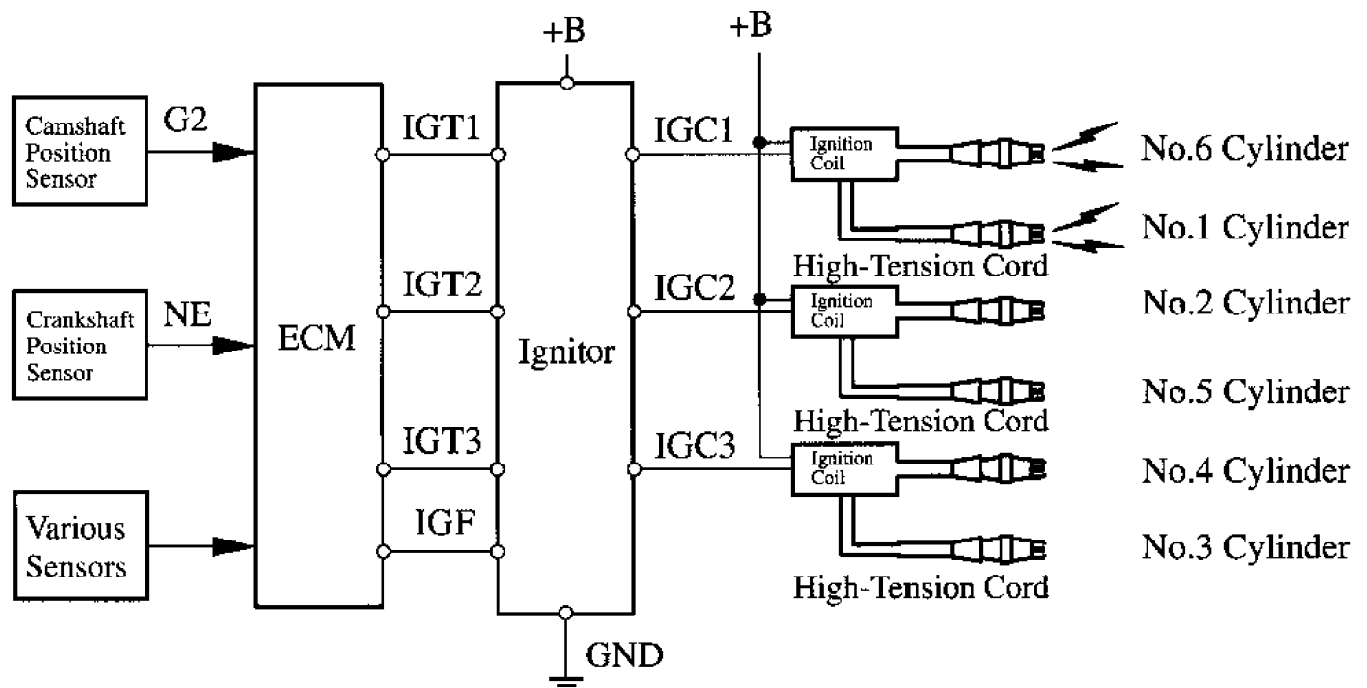
The Distributorless Ignition System (DIS) uses the Engine Control Module (ECM) for determining ignition timing (spark advance).

The ECM may determine ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signal.

NOTE: Camshaft position sensor may also be referred to as cam position sensor.

Conventional distributor and pick-up coil have been replaced by camshaft position sensor and crankshaft position sensor. Camshaft position sensor and crankshaft position sensor deliver input signals to ECM. The ECM detects the standard crankshaft position based on camshaft position sensor input signals, and the actual crankshaft position and engine speed by the crankshaft position sensor input signals. Camshaft position sensor is located just above the intake manifold on rear corner of cylinder head, just below the valve cover. See Figs. 15-16. Crankshaft position sensor is located near crankshaft pulley, just above oil pan on passenger's side of engine. See Figs. 15-16. For knock sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

The ECM uses 3 ignition primary control signals to the ignitor for the ignition coils. The DIS uses 3 ignition coils to fire 2 cylinders simultaneously using the same ignition coil. See Fig. 32. Cylinder No. 1 is front cylinder at front of engine. Cylinder No. 6 is the rear cylinder at flywheel end of engine. One ignition coil is mounted on top of spark plug on cylinders No. 2, 4 and 6. Spark plug wires are routed from ignition coils on top of spark plugs to the spark plugs on the remaining cylinders. The ECM monitors IGF circuit at the ignitor to ensure ignition coils have fired.



98A01636

Fig. 32: Distributorless Ignition System Schematic (Supra Non-Turbo)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

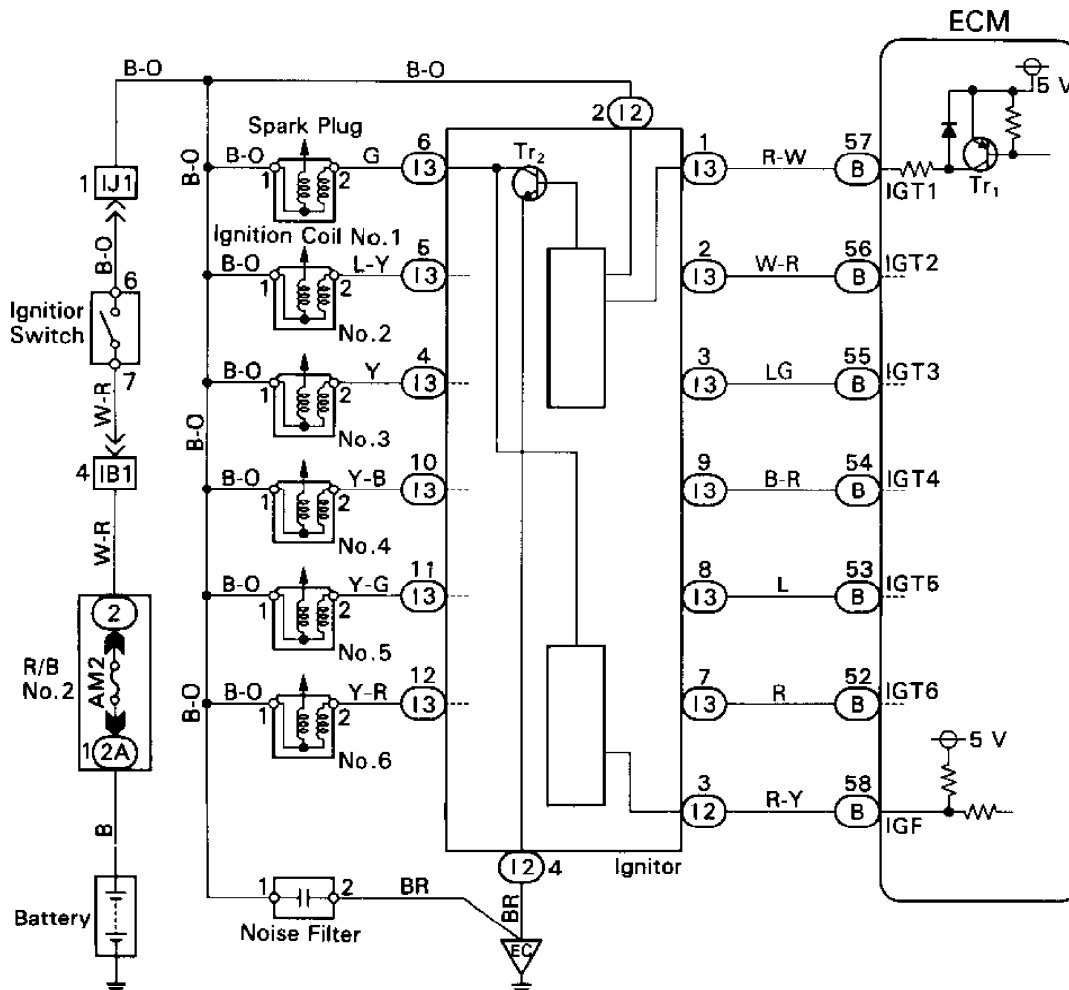
Supra Turbo

Distributorless Ignition System (DIS) uses the Engine Control Module (ECM) for determining ignition timing (spark advance). The ECM may determine ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signal.

NOTE: Camshaft position sensor may also be referred to as cam position sensor.

Conventional distributor and pick-up coil have been replaced by 2 camshaft position sensors and a crankshaft position sensor. Camshaft position sensors and crankshaft position sensor deliver input signals to ECM. The ECM detects the standard crankshaft position based on camshaft position sensor input signals, and the actual crankshaft position and engine speed by the crankshaft position sensor input signals. Camshaft position sensors are located on intake manifold side of cylinder head. See Figs. 15-16. Crankshaft position sensor is located near crankshaft pulley, just above oil pan on passenger's side of engine. See Figs. 15-16. For knock sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

The ECM uses 6 ignition primary control signals for the ignition coils. See Fig. 33. The ECM monitors IGF circuit at the ignitor to ensure ignition coils have fired.



97G06298

Fig. 33: Distributorless Ignition System Schematic (Supra Turbo)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Tacoma 2.4L 4-Cyl. & 2.7L 4-Cyl., T100 2.7L 4-Cyl. & 4Runner
2.7L4-Cyl.

Distributorless Ignition System (DIS) uses the Engine Control Module (ECM) for determining ignition timing (spark advance). The ECM may determine ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signal.

NOTE: Camshaft position sensor may also be referred to as cam position sensor.

Conventional distributor and pick-up coil have been replaced by a camshaft position sensor and crankshaft position sensor. Camshaft position sensor and crankshaft position sensor deliver input signals to ECM. The ECM detects the standard crankshaft position based on camshaft position sensor input signals, and the actual crankshaft position and engine speed by the crankshaft position sensor input signals. Camshaft position sensor is located at driver's side front corner of cylinder head, just in front of the intake manifold. See Figs. 17-21. Crankshaft position sensor is located near crankshaft pulley, just above oil pan on driver's side of engine. See Figs. 17-21. For knock sensor location, see N - REMOVE/INSTALL/OVERHAUL article.

The ECM uses 2 ignition primary control signals to the ignitor for the ignition coils. The DIS uses 2 ignition coils with internal ignitors to fire 2 cylinders simultaneously using the same ignition coil. See Fig. 30. Cylinders No. 1 and 4 fire together and cylinders No. 2 and 3 fire together. Cylinder No. 1 is front cylinder at timing chain end of engine and cylinder No. 4 is the rear cylinder at flywheel end of engine. Ignition coils are mounted near front of cylinder head. The ECM monitors IGF circuit at the ignitor to ensure ignition coils have fired.

Tacoma 3.4L V6, T100 3.4L V6 & 4Runner 3.4L V6

Distributorless Ignition System (DIS) uses the Engine Control Module (ECM) for determining ignition timing (spark advance). The ECM may determine ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signals.

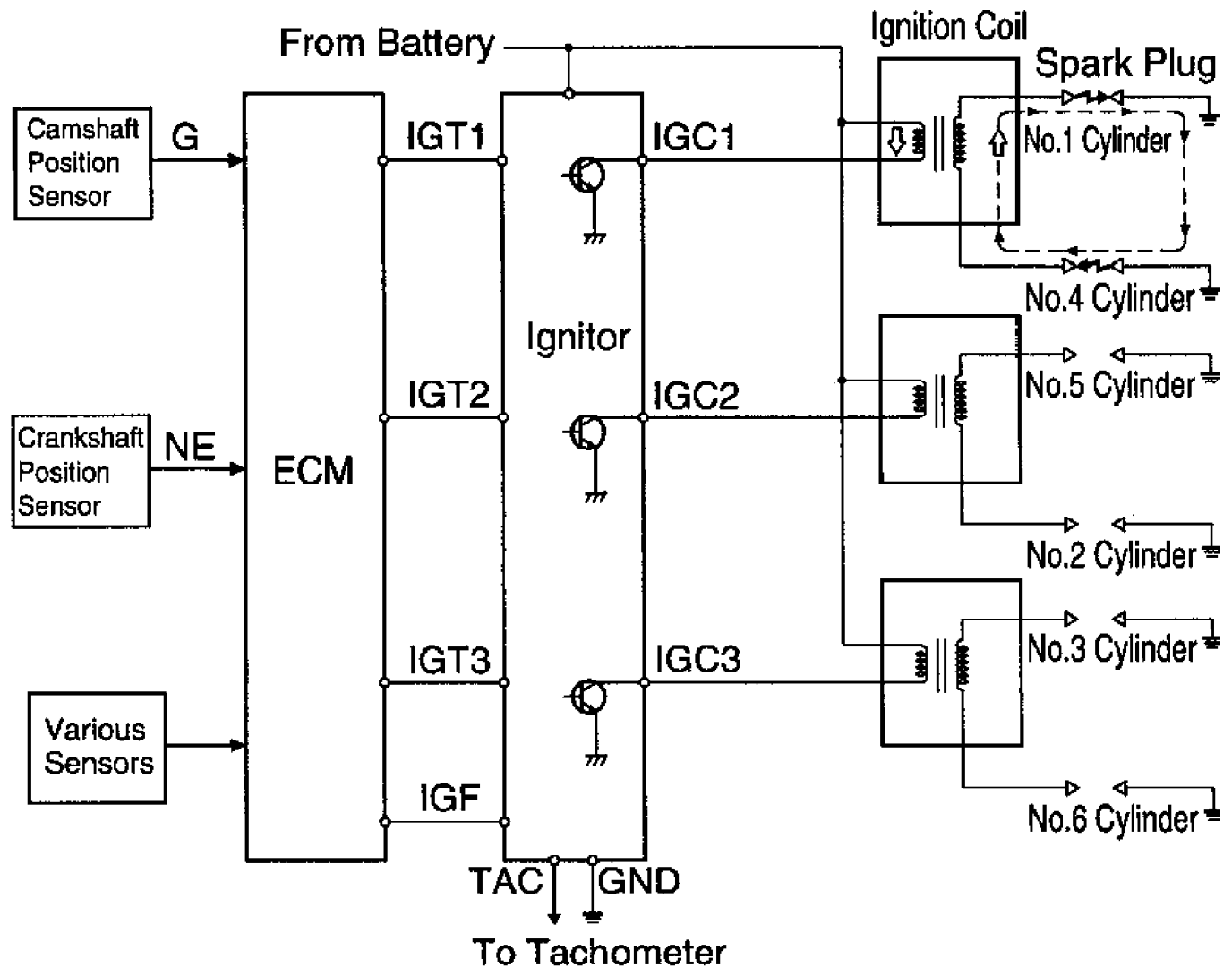
NOTE: Camshaft position sensor may also be referred to as cam position sensor.

Conventional distributor and pick-up coil have been replaced by a camshaft and crankshaft position sensor. Camshaft position sensor and crankshaft position sensor deliver input signals to ECM. The ECM detects the standard crankshaft position based on camshaft position sensor input signals, and the actual crankshaft position and engine speed by the crankshaft position sensor input signals. Camshaft position sensor is located behind timing belt cover, near passenger's side camshaft sprocket. See Figs. 17-18 and 21-23. Crankshaft position sensor is located at front of engine, just above crankshaft pulley. See Figs. 17-18 and 21-23.

The ECM uses 3 ignition primary control signals to the ignitor for the ignition coils. See Fig. 34. The DIS uses 3 ignition coils which fire 2 cylinders simultaneously using the same ignition coil. Cylinders No. 1 and 4 fire together, 2 and 5 fire together, and 3 and 6 fire together. Cylinder No. 1 is front cylinder on right side of engine when viewed from the flywheel end of engine. Cylinder No. 2 is front cylinder on left side of engine when viewed from flywheel end of engine. Cylinders No. 1, 3 and 5 are on right side of engine. Cylinders No. 2, 4 and 6 are on left side of engine.

One ignition coil is mounted on top of spark plug on cylinder No. 1 with spark plug wire going to cylinder No. 4 spark plug. One ignition coil is mounted on top of spark plug on cylinder No. 3 with spark plug wire going to cylinder No. 6 spark plug. One ignition coil is mounted on top of spark plug on cylinder No. 5 with spark plug wire

going to cylinder No. 2 spark plug. The ECM monitors IGF circuit at the ignitor to ensure ignition coils have fired.



95131318

Fig. 34: Distributorless Ignition System Schematic (Tacoma 3.4L V6, T100 3.4L V6 & 4Runner 3.4L V6)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Tercel

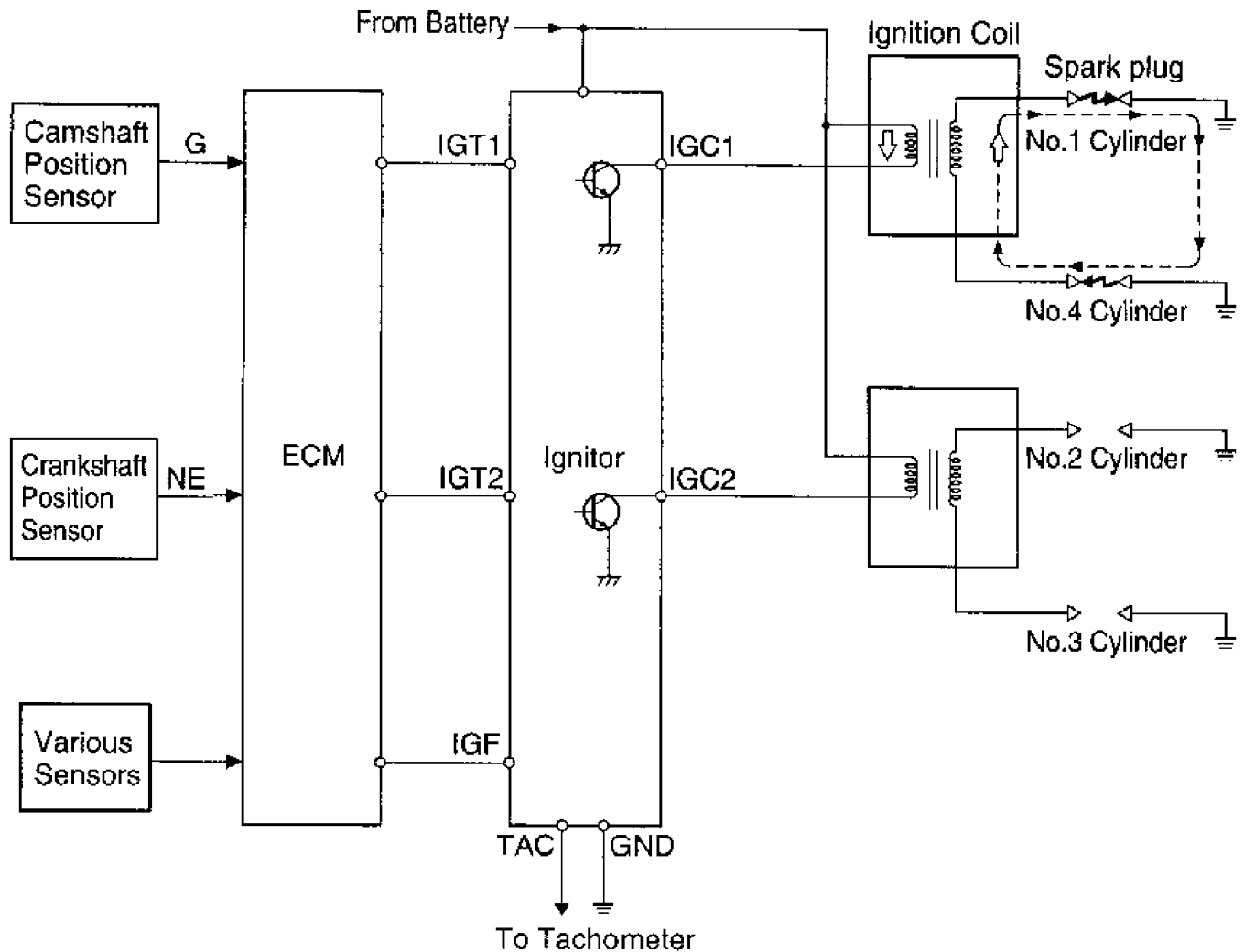
Distributorless Ignition System (DIS) uses the Engine Control Module (ECM) for determining ignition timing (spark advance). The ECM determines ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signal.

NOTE: Camshaft position sensor may also be referred to as cam position sensor.

Conventional distributor and pick-up coil have been replaced by a camshaft and crankshaft position sensor. Camshaft position sensor and crankshaft position sensor deliver input signals to ECM. The ECM detects the standard crankshaft position based on camshaft position sensor input signals, and the actual crankshaft position and engine

speed by the crankshaft position sensor input signals. Camshaft position sensor is located on end of cylinder head, just above the flywheel. See Figs. 19-20. Crankshaft position sensor is located at timing belt end of engine, behind timing belt cover, near sprocket on crankshaft. See Figs. 19-20.

The ECM uses 2 ignition primary control signals to the ignitor for the ignition coils. See Fig. 35. The DIS uses 2 ignition coils which fire 2 cylinders simultaneously using the same ignition coil. See Fig. 35. Cylinder No. 1 is at timing belt of engine and cylinder No. 4 is at flywheel end of engine. One ignition coil is mounted on top of spark plug on cylinder No. 3 with spark plug wire going to cylinder No. 2 spark plug. One ignition coil is mounted on top of spark plug on cylinder No. 4 with spark plug wire going to cylinder No. 1 spark plug. The ECM monitors IGF circuit at the ignitor to ensure ignition coils have fired.



95G31316

Fig. 35: Distributorless Ignition System Schematic (Tercel)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

DISTRIBUTOR TYPE IGNITION SYSTEM

NOTE: The distributor type ignition system may be referred to as Electronic Spark Advance (ESA) system.

Celica

Ignition system uses the Engine Control Module (ECM) for determining ignition timing (spark advance). ECM may determine ignition timing (spark advance) based on various input signals, engine RPM and knock sensor input signal. Ignition coil is mounted in the engine compartment.

NOTE: Camshaft position sensor in the distributor may be referred to as pick-up coil in distributor.

Camshaft position sensor (pick-up coil) and crankshaft position sensor deliver input signals to ECM. The ECM detects the standard crankshaft position based on camshaft position sensor input signal, and the actual crankshaft position and engine speed by the crankshaft position sensor input signals. Crankshaft position sensor is located at timing belt end of engine, behind timing belt cover, near sprocket on crankshaft. See Figs. 9-10.

The ECM determines ignition timing and delivers an output ignition signal to the ignitor on the IGT wire. Since the width of the IGT signal is constant, the dwell angle control circuit in the ignitor determines the time the control circuit starts primary current flow to the ignition coil based on engine RPM and ignition timing one revolution ago.

When ignition timing is obtained, the primary circuit is turned off when ECM delivers a signal to ignitor on the IGT wire, causing ignition coil to fire the spark plug. After delivering a command to turn off primary circuit on the IGT wire, the ECM monitors IGF circuit to ignitor to ensure primary switching occurred. The ECM stops fuel injection as a fail-safe function when IGF reference signal has not been received.

EMISSION SYSTEMS

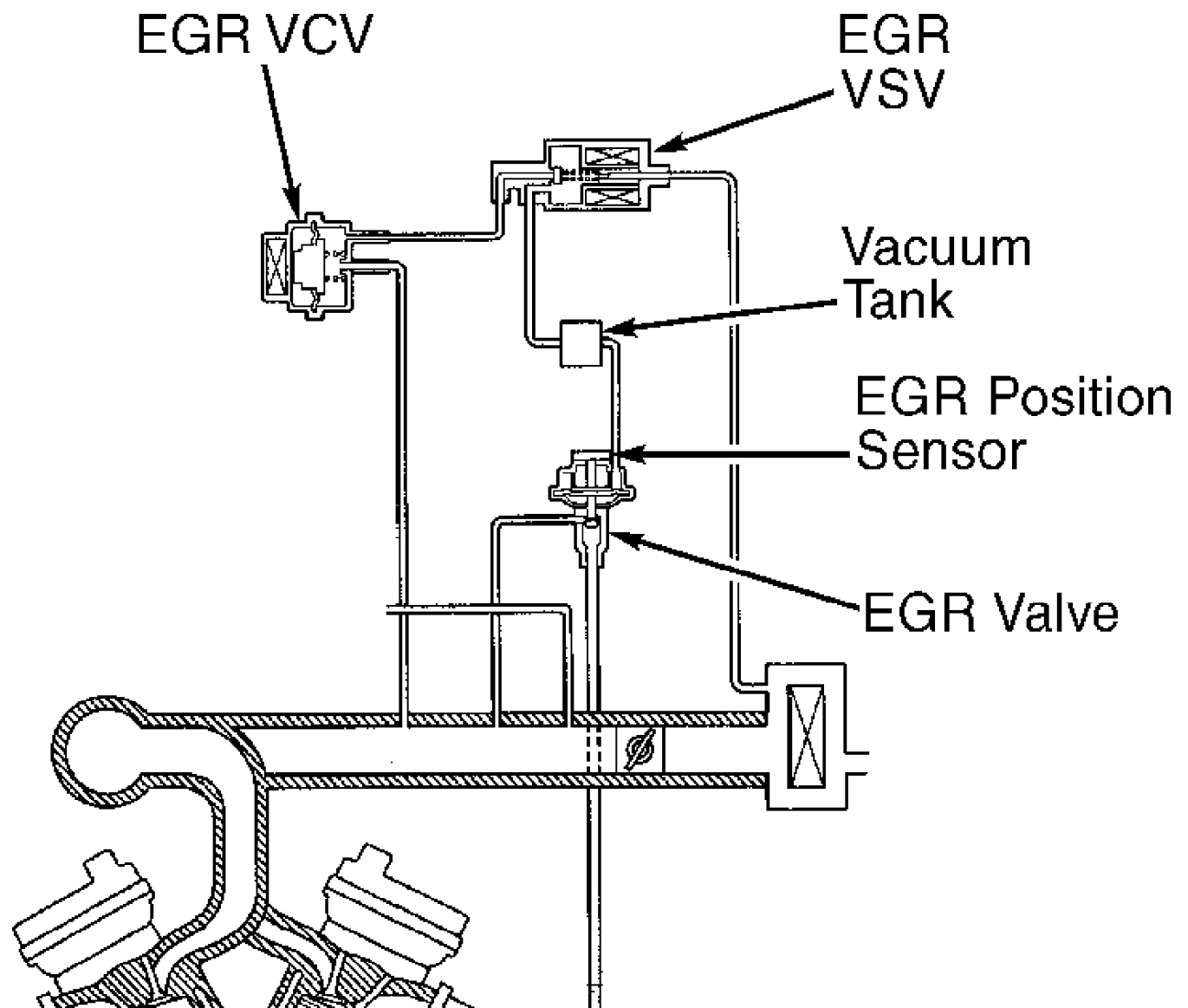
EXHAUST GAS RECIRCULATION (EGR) SYSTEM

Avalon & Camry 3.0L V6

The EGR system reduces oxides of nitrogen (NOx) emissions by lowering combustion temperatures. Combustion temperatures are lowered by recycling metered amount of exhaust gases back into the intake system.

The EGR system contains a vacuum-operated EGR valve, EGR Vacuum Control Valve (VCV), EGR position sensor and a vacuum tank. See Fig. 36. An EGR gas temperature sensor is screwed into the lower side of EGR valve.

The EGR VCV regulates the intake manifold vacuum applied to the EGR Vacuum Switching Valve (VSV). The EGR operation is controlled by EGR VSV which is operated by the Engine Control Module (ECM). The EGR position sensor monitors movement of EGR valve and delivers an input signal to the ECM. The ECM uses this input signal to obtain the correct amount of EGR valve opening in relation to the engine operation. The ECM uses various input signals for controlling the EGR VSV. For EGR system and component testing, see I - SYSTEM/COMPONENT TESTS article.



97106299

Fig. 36: Identifying EGR System Components (Avalon & Camry 3.0L V6)
 Courtesy of Toyota Motor Sales, U.S.A., Inc.

Camry 2.2L 4-Cyl., Celica, RAV4, Supra Turbo, Tacoma 2.4L 4-Cyl. & 2.7L 4-Cyl., Tacoma 3.4L V6 2WD All Models & 4WD Regular Cab, T100 2.7L 4-Cyl., T100 3.4L V6 2WD 1/2 Ton & 4Runner 2.7L 4-Cyl.

The EGR system reduces oxides of nitrogen (NOx) emissions by lowering combustion temperatures. Combustion temperatures are lowered by recycling metered amount of exhaust gases back into the intake system. The EGR system contains a vacuum-operated EGR valve, EGR vacuum modulator and EGR Vacuum Switching Valve (VSV). See Fig. 37-38. EGR vacuum modulator regulates exhaust backpressure and balances atmospheric pressure and vacuum to allow EGR operation at heavy throttle. The EGR valve operation is controlled by EGR VSV which is controlled by the Engine Control Module (ECM).

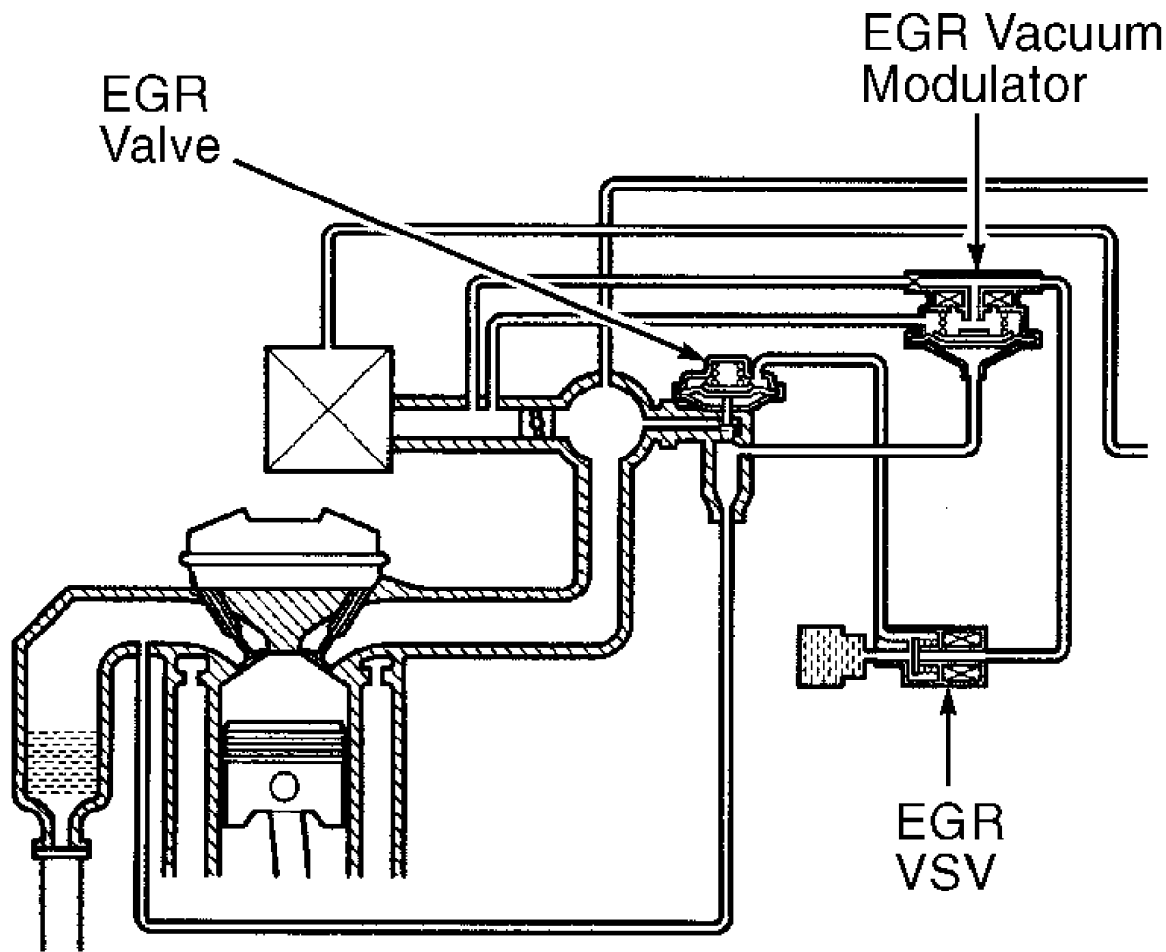
On Tacoma, T100 and 4Runner, EGR gas temperature sensor is

used in the EGR system. On all models, ECM uses various input signals for controlling EGR system operation. For EGR system and component testing, see I - SYSTEM/COMPONENT TESTS article.

Supra Turbo

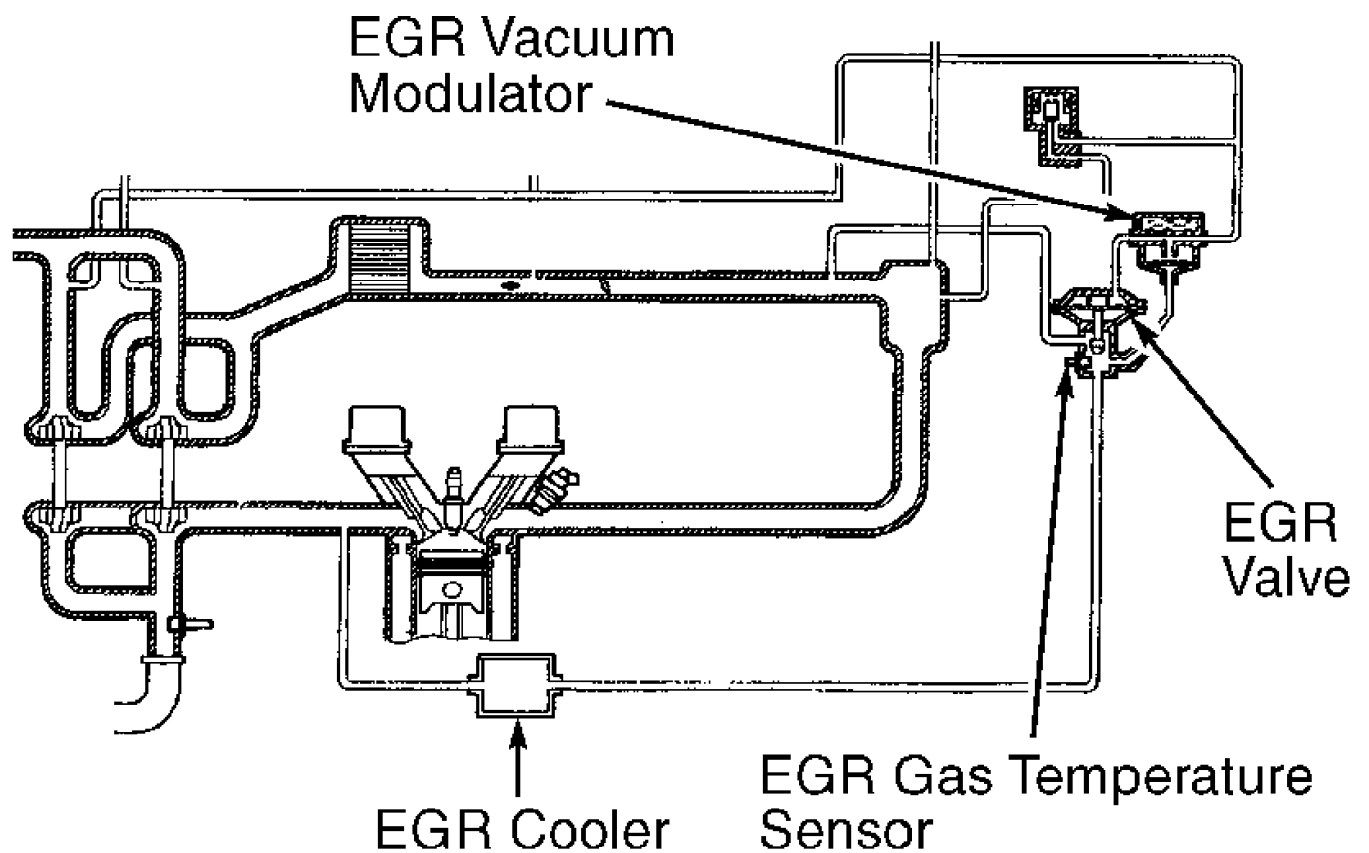
The EGR system reduces oxides of nitrogen (NO_x) emissions by lowering combustion temperatures. Combustion temperatures are lowered by recycling metered amount of exhaust gases back into the intake system. The EGR system contains a vacuum-operated EGR valve, EGR vacuum modulator, EGR Vacuum Switching Valve (VSV), EGR gas temperature sensor and EGR cooler. See Fig. 37-38. EGR vacuum modulator regulates exhaust backpressure and balances atmospheric pressure and vacuum to allow EGR operation at heavy throttle.

The EGR valve operation is controlled by EGR VSV which is controlled by the Engine Control Module (ECM). The ECM uses various input signals for controlling EGR system operation. The EGR cooler is used to assist in reducing exhaust gas temperature before entering combustion chamber. For EGR system and component testing, see I - SYSTEM/COMPONENT TESTS article.



98E01638

Fig. 37: Identifying Typical EGR System Components (Camry 2.2L 4-Cyl., Celica & RAV4 Tacoma, T100 & 4Runner)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



98G01639

Fig. 38: Identifying Typical EGR System Components (Supra Turbo)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

EVAPORATIVE EMISSION (EVAP) SYSTEM

NOTE: The EVAP may also be referred to as fuel evaporation.

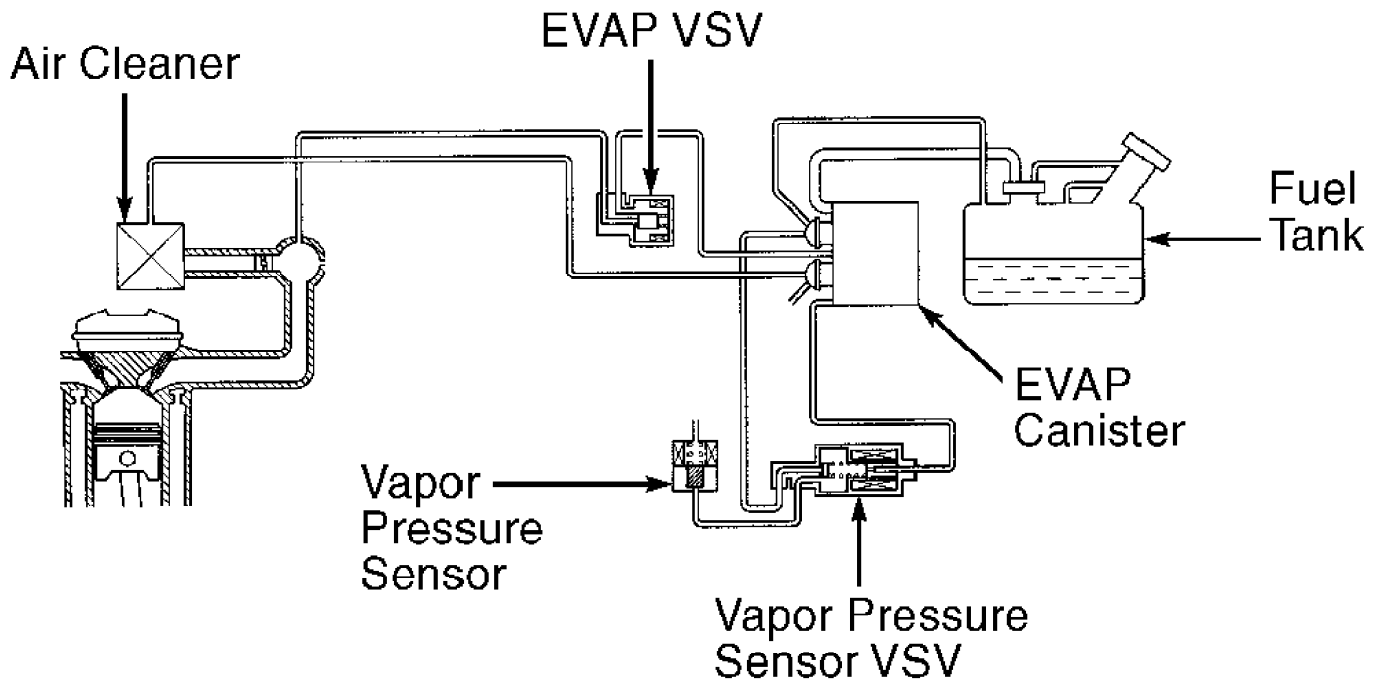
Avalon, Camry, Celica Calif. Emission Vehicles, Corolla, Land Cruiser, RAV4, Sienna, Supra Non-Turbo, Tacoma, Tercel, T100 & 4Runner

The EVAP system prevents fuel tank gasoline vapors from escaping into the atmosphere. Fuel tank gasoline vapors are routed through EVAP canister into air cleaner and intake manifold for combustion in the cylinders. See Fig. 39.

The Engine Control Module (ECM) monitors fuel tank pressure to determine if a leak or an abnormality exists in the EVAP system. A vapor pressure sensor Vacuum Switching Valve (VSV) is located in vapor line to the EVAP canister. Vapor pressure sensor VSV may also be referred to as EVAP Vapor Pressure Sensor Vacuum Switching Valve (EVAP-VPSVSV).

The ECM will operate the vapor pressure VSV, allowing vapor pressure sensor to monitor the fuel tank pressure and EVAP system. Vapor pressure sensor delivers an input signal to ECM to indicate fuel tank pressure. If a leak or an abnormality exists in the EVAP system, a diagnostic trouble code will be stored in the ECM. Vapor pressure sensor may be referred to as EVAP vapor pressure sensor.

An EVAP Vacuum Switching Valve (VSV) is used to control EVAP system. The ECM operates EVAP VSV which controls the vacuum flow for EVAP operation. For EVAP system and component testing, see I - SYSTEM/COMPONENT TESTS article.

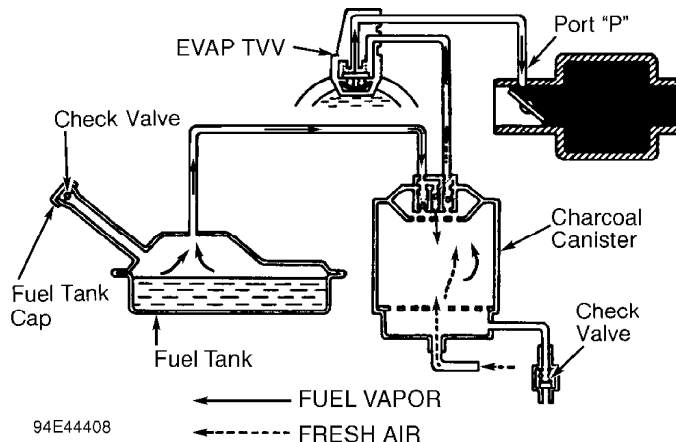


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Fig. 39: Identifying Typical EVAP System Components (Avalon, Camry, Celica Calif. Emission Vehicles, Corolla, Land Cruiser, LX470, RAV4, Sienna, Supra Non-Turbo, Tacoma, Tercel, T100 & 4Runner)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Celica Except Calif. Emission Vehicles

The EVAP system prevents fuel tank gasoline vapors from escaping into the atmosphere. Fuel tank gasoline vapors are routed through charcoal canister into intake manifold for combustion in the cylinders. See Fig. 40. An EVAP Thermal Vacuum Valve (TVV), mounted in the engine coolant passage, is used to control EVAP system in relation to engine coolant temperature. For EVAP system and component testing, see I - SYSTEM/COMPONENT TESTS article.

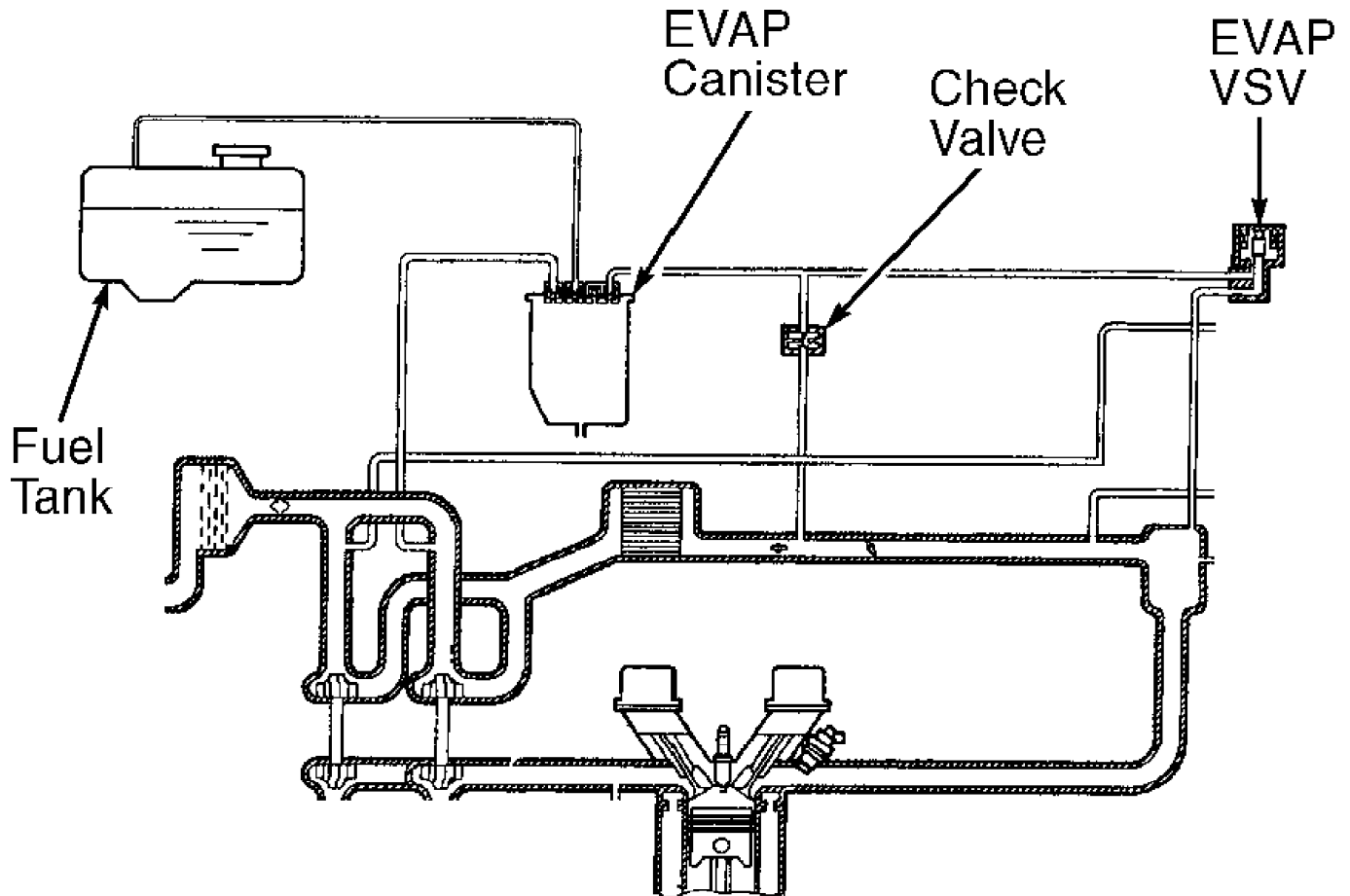


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Fig. 40: Identifying Typical EVAP System Components (Celica Except Calif. Emission Vehicles)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

Supra Turbo

The EVAP system prevents fuel tank gasoline vapors from escaping into the atmosphere. Fuel tank gasoline vapors are routed through charcoal canister into intake manifold for combustion in the cylinders. See Fig. 41. An EVAP Vacuum Switching Valve (VSV) is used to control EVAP system. The Engine Control Module (ECM) operates EVAP VSV which controls the vacuum flow for EVAP operation. For EVAP system and component testing, see I - SYSTEM/COMPONENT TESTS article.



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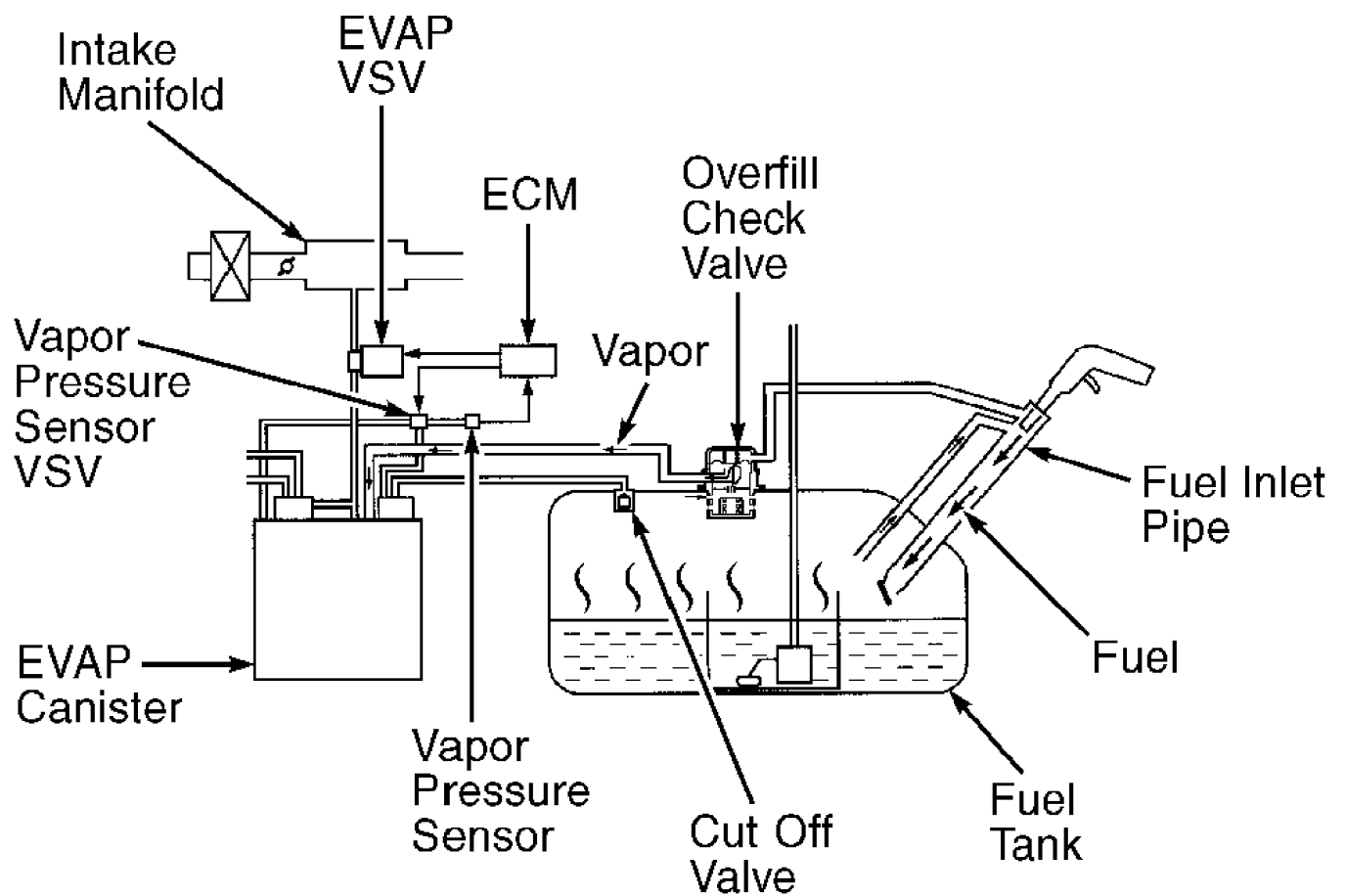
Fig. 41: Identifying EVAP System Components (Supra Turbo)
 Courtesy of Toyota Motor Sales, U.S.A., Inc.

ON-BOARD REFILLING VAPOR RECOVERY (ORVR) SYSTEM

Camry 2.2L 4-Cyl. & Corolla

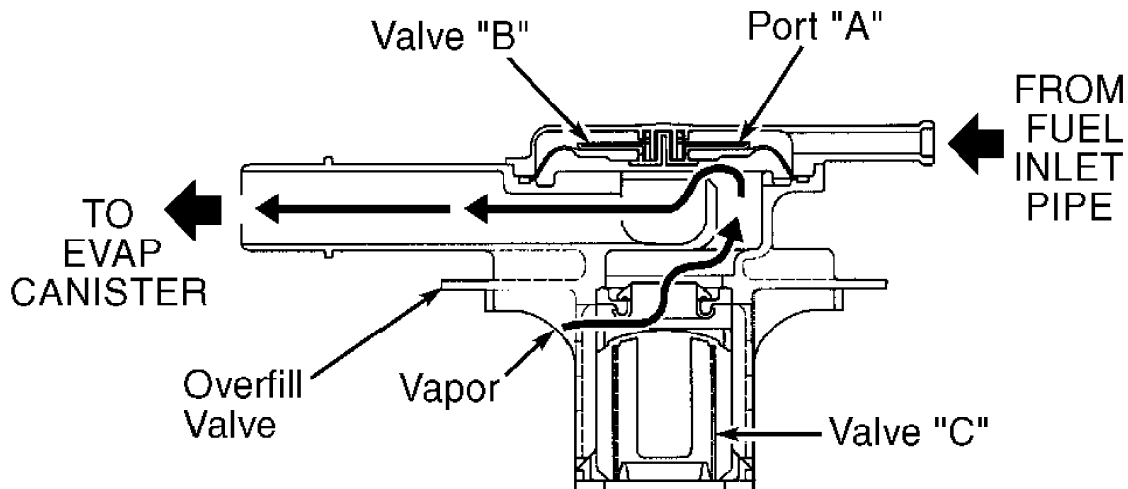
The ORVR system is used to recover fuel vapors into the EVAP canister that are generated during refueling. ORVR system consists of fuel inlet pipe, overfill check valve and EVAP canister. See Fig. 42.

When fuel tank cap is removed, atmospheric pressure is applied to port "A" on overfill check valve. See Fig. 42. Overfill check valve may also be referred to as ORVR-OCKV or fill check valve. When fuel flows into fuel inlet pipe and fuel tank, the pressure in the fuel tank increases. Increased pressure in the fuel tank causes valve "B" on overfill valve to open, allowing fuel vapors to flow into the EVAP canister. When fuel tank is full, valve "C" closes, shutting off the vapor flow to the EVAP canister.



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Fig. 42: Locating ORVR System Components (Camry 2.2L 4-Cyl., Celica Calif. Emission Vehicles & Corolla)
Courtesy of Toyota Motor Sales, U.S.A., Inc.



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Fig. 43: Locating Port & Valves On Overfill Valve & Identifying Vapor Flow (Camry 2.2L 4-Cyl., Celica Calif. Emission Vehicles & Corolla)
Courtesy of Toyota Motor Sales, U.S.A., Inc.

POSITIVE CRANKCASE VENTILATION

The Positive Crankcase Ventilation (PCV) system prevents crankcase vapors from escaping into the atmosphere. Crankcase vapors are routed from crankcase through a vacuum-controlled PCV valve and then delivered back into the cylinders. The PCV system provides primary control of crankcase blow-by vapors, according to manifold vacuum. When manifold vacuum is high (at idle), PCV restricts vapor flow to maintain a smooth idle condition.

SELF-DIAGNOSTIC SYSTEM

The Engine Control Module (ECM) is equipped with self-diagnostic system. By analyzing various input signals, ECM detects system malfunctions related to various operating parameters. When malfunction occurs, ECM will inform the driver by turning on Malfunction Indicator Light (MIL) on the instrument panel.

NOTE: The MIL may be referred to as the CHECK ENGINE light.

Diagnostic Trouble Codes (DTC) may be set by malfunction of various engine sensors, switches or circuits. DTC is stored in ECM memory. When diagnostic trouble code is stored, MIL on instrument panel will come on. Diagnostic trouble code can be retrieved for system diagnosis. For additional information on self-diagnostic system, see appropriate SELF-DIAGNOSTICS article.

MISCELLANEOUS CONTROLS

NOTE: Although not considered true engine performance-related systems, some controlled devices may affect driveability if the malfunction.

TRANSMISSION/TRANSAXLE CONTROLS

NOTE: Only electronically controlled transmissions/transaxles are covered. Some models have transmissions and transaxles that are not electronically controlled.

Electronically Controlled Transmission/Transaxle (ECT)
The Engine Control Module (ECM) uses input signals for controlling transmission/transaxle operation.