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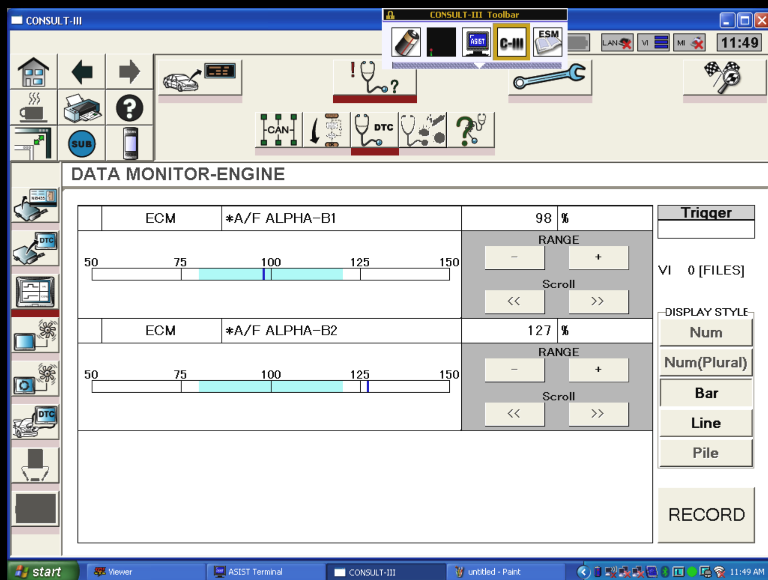
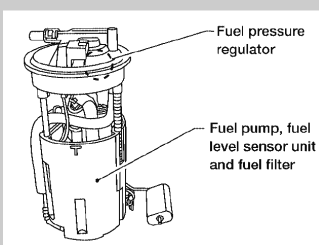
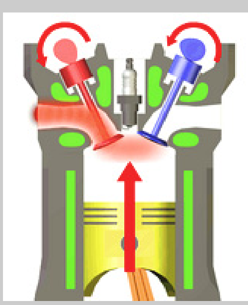


Service Technician Workbook



ECCS Operations Diagnosis & Repair



NISSAN

INFINITI

CREATED SEPTEMBER, 2009

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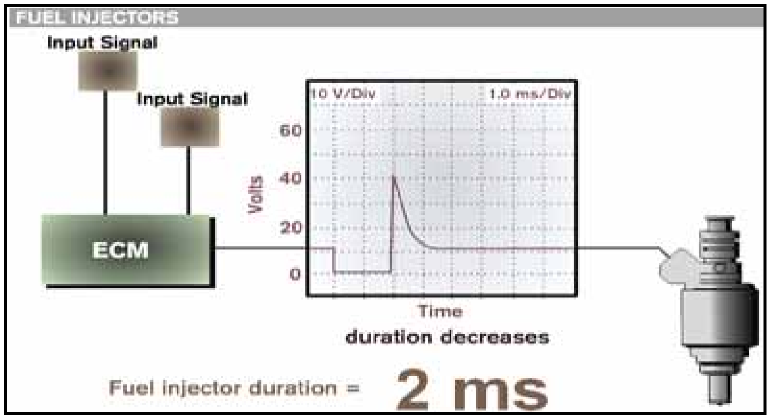
INTRODUCTION TO ECCS

Engine Control System

The Electronic Concentrated Control System consists of sophisticated components that manage the combustion process for Nissan and Infiniti vehicles.



ECCS systems have evolved since their debut on the 280ZX in 1981. Nissan and Infiniti ECCS controls now manage everything from OBD II emission control systems to the Variable Valve Event and Lift controls introduced on the G37 and 370Z.

All internal combustion gasoline engines require three things in order to run:

- A mixture of Air and Fuel
- A spark to ignite the mixture
- Compression to provide power to push the pistons

The ECCS System uses an Engine Control Module (ECM or ECU) to gather input information from a host of sensors. These sensors provide details about the amount of air and fuel the engine requires, and they inform the ECM regarding how much air and fuel the engine is using. The ECM uses the data from these sensors to adjust the air fuel mixture for the most efficient combination of low emissions and powerful performance.

The amount of air entering the intake manifold is measured by the Mass Air Flow sensor (MAF), and air flow is controlled by the Electronic Throttle (ETC). An electric pump supplies fuel pressure to a fuel rail and the ECM energizes a fuel injector which sprays a precise amount of fuel into the intake manifold.

The ECCS system features many additional sensors and components to control the air and fuel supplied to the engine under all possible operating conditions, and this text will cover those in detail - but the first step in troubleshooting ‘no start’ conditions is to check air, fuel, spark and compression.

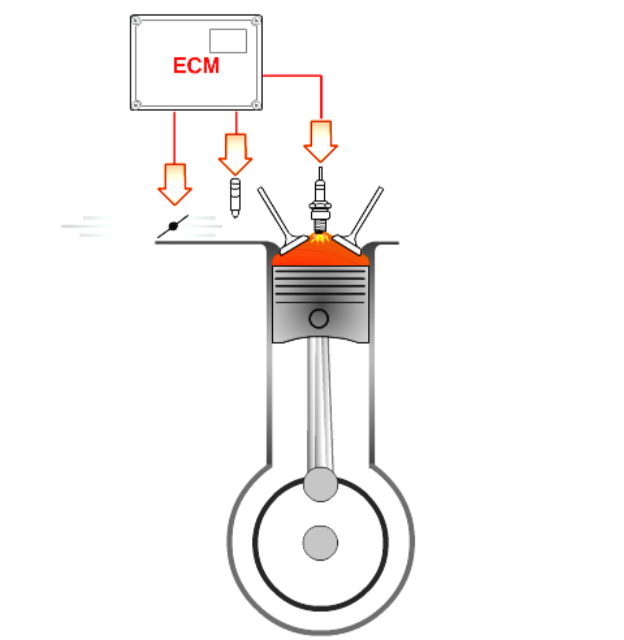
The spark required to ignite the air fuel mixture is controlled by the ECM. Most Nissan and Infiniti vehicles feature a Direct Ignition system with an ignition coil for each cylinder. The ECM controls the timing of the spark based on engine RPM and other engine operating conditions.

The engine must have adequate compression in order to start. Although the ECCS course does not focus on the mechanical condition of the engine, this must not be overlooked when diagnosing driveability or starting problems.

The ECM controls the air intake through the electronic throttle. Fuel is injected when the ECM energizes the fuel injector.The spark plug ignites the air / fuel mixture based on timing controlled by the ECM.

If the compression chamber is sealing properly - that is, if the valves, piston rings and pistons are in good condition - the burning air fuel mixture will expand and push down on the piston providing the power required to start the engine.

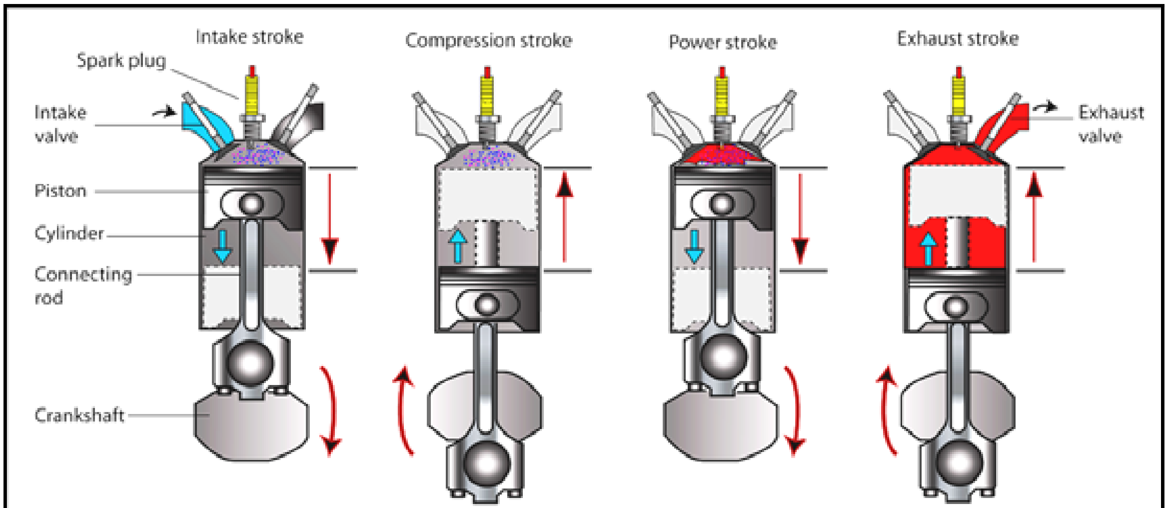
Troubleshooting the ECCS system begins with confirming that the ECM and engine are performing these basic functions.



Four-Stroke Engine Operation

The Four Stroke Cycle

The graphic below illustrates the 4 stroke cycle. Air and fuel enter the combustion during the intake stroke, the mixture is compressed during the compression stroke, the burning mixture pushes on the piston during the power stroke and the burned mixture is forced out of the combustion chamber during the exhaust stroke.

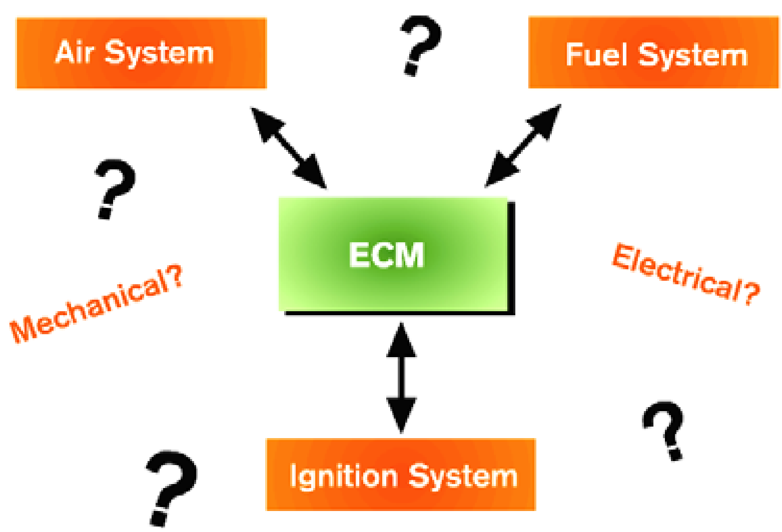


The Engine Mechanical course offered in the Nissan and Infiniti training centers provides detailed information regarding engine technologies. This course features shop work to measure and evaluate the condition of all major engine components.

There are several SIR videos that review basic engine technology including:

- Volume N54 / I36: Exploring Engine Technology
- Volume 95: New Technologies
- Volume 145: Variable Valve Event and Lift

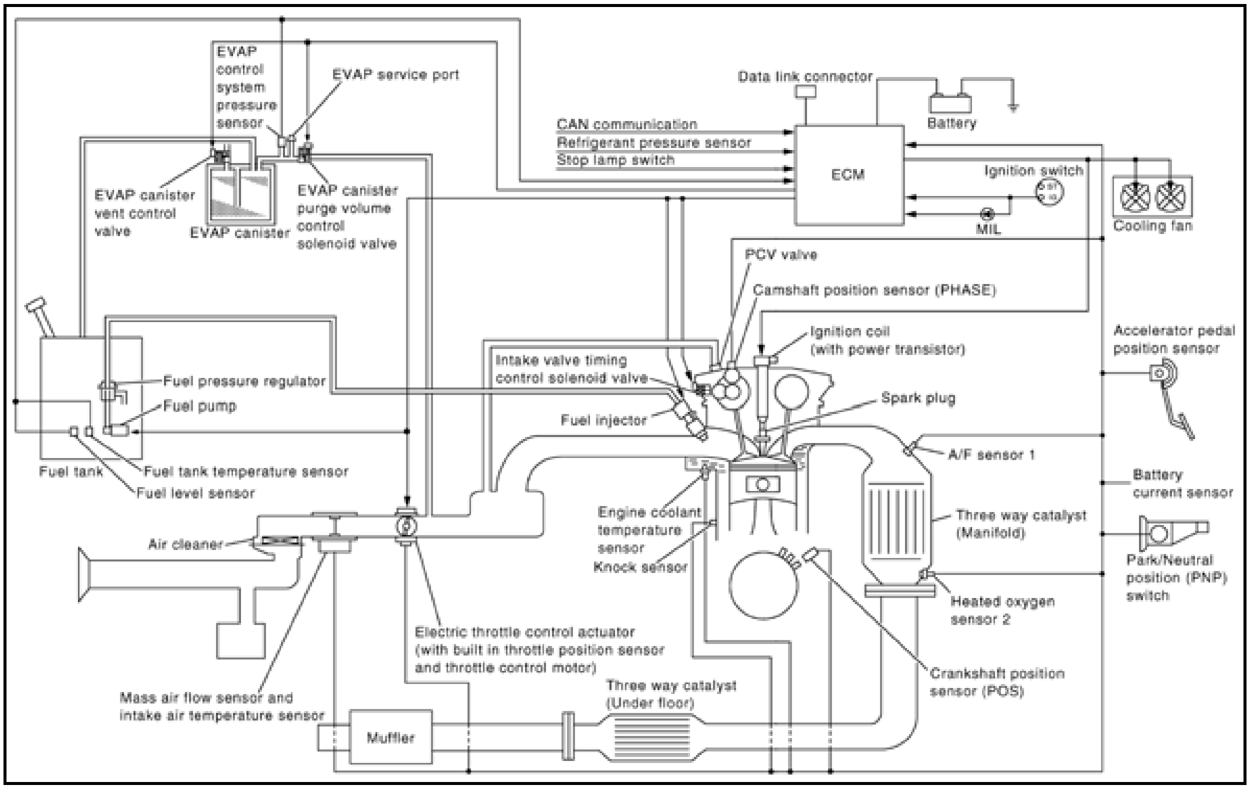
A prerequisite to enrolling in the Engine Mechanical course is the On-Line Training program titled 'Introduction to Engine Mechanical Service'. (EMTC9915-OLT) Watch this program to learn the basics of Nissan and Infiniti engine technology.



Troubleshooting problems with the ECCS Engine Control system requires starting with the basics.

- Confirm the ignition system is providing a strong spark at the correct time
- Confirm the vehicle has air and fuel
- Confirm the engine is in good mechanical condition and has adequate compression

ECCS Systems and Components



The schematic drawing above is typical of Nissan and Infiniti ECCS controls. The major components controlling emissions and performance are featured in this illustration.

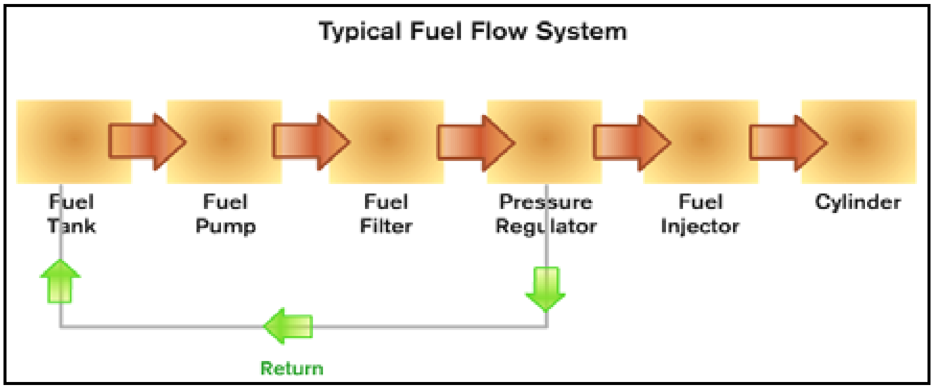
The ECCS system performs the following basic functions:

- Controls the electric fuel pump
- Controls the amount and timing of fuel supplied through the fuel injectors
- Measures and controls the amount of air entering the intake manifold
- Provides a correctly timed ignition spark
- Provides ‘feedback’ to the ECM to produce the most efficient air fuel mixture
- Diagnoses problems with input sensors or output actuators and illuminates the Service Engine Soon lamp as required
- Controls hydrocarbon emissions by monitoring the condition of the Evaporative system

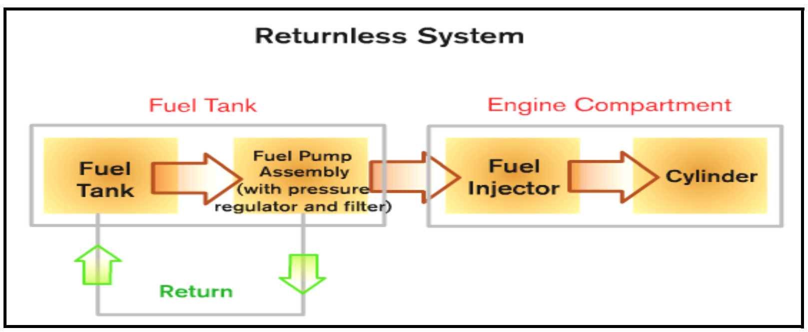
Fuel Pump Control

Nissan and Infiniti ECCS systems pressurize the fuel in the tank and deliver that fuel to the fuel injection manifold.

Older systems, (pre 2002) used a vacuum operated pressure regulator to vary pressure between 34 and 43 PSI.



Current fuel pumps deliver 51 PSI to the fuel injector manifold whenever the vehicle is running. The tank mounted pump assembly internally regulates pressure to the 51 PSI specification.

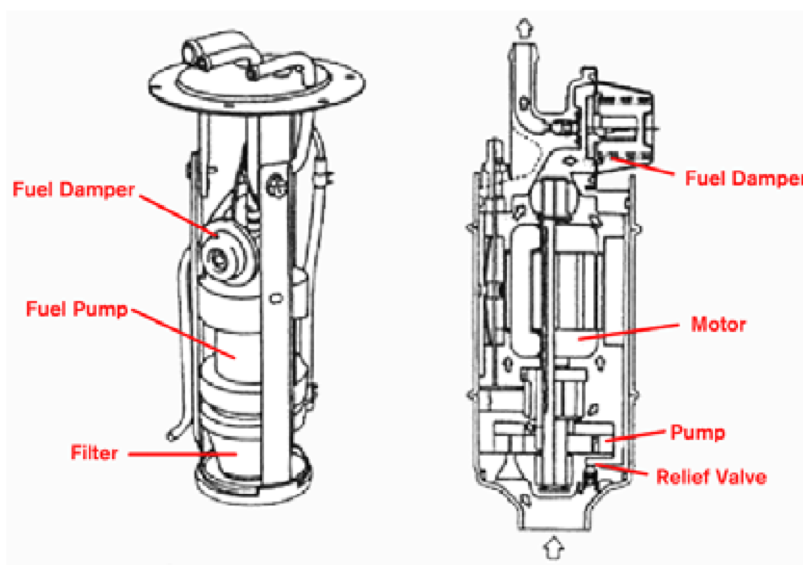


Nissan and Infiniti fuel pumps are installed in the fuel tank.

The dampers and pressure regulators are integral to the pump assembly.

The fuel pump needs to be thoroughly sealed at its mounting points so fuel vapors cannot escape from the fuel tank.

Check with the ESM. Some Nissan and Infiniti vehicles require special tools to remove the fuel pump lock ring.



The ECM controls the fuel pump. By regulation, the fuel pump must be turned Off if the engine is not running. When the vehicle is started, the fuel pump will operate for 1 second, but will then turn Off if the engine is not running. ECCS uses the input signals from the crankshaft or camshaft position sensors to the ECM to confirm the engine is running. The ECM will then continue to energize the fuel pump.

There are only two ECM input signals that control fuel pump operation. Engine Speed information is provided by the Crankshaft or Camshaft Position sensors and the Ignition Switch provides an ‘ON or START’ signal.

FUEL PUMP CIRCUIT

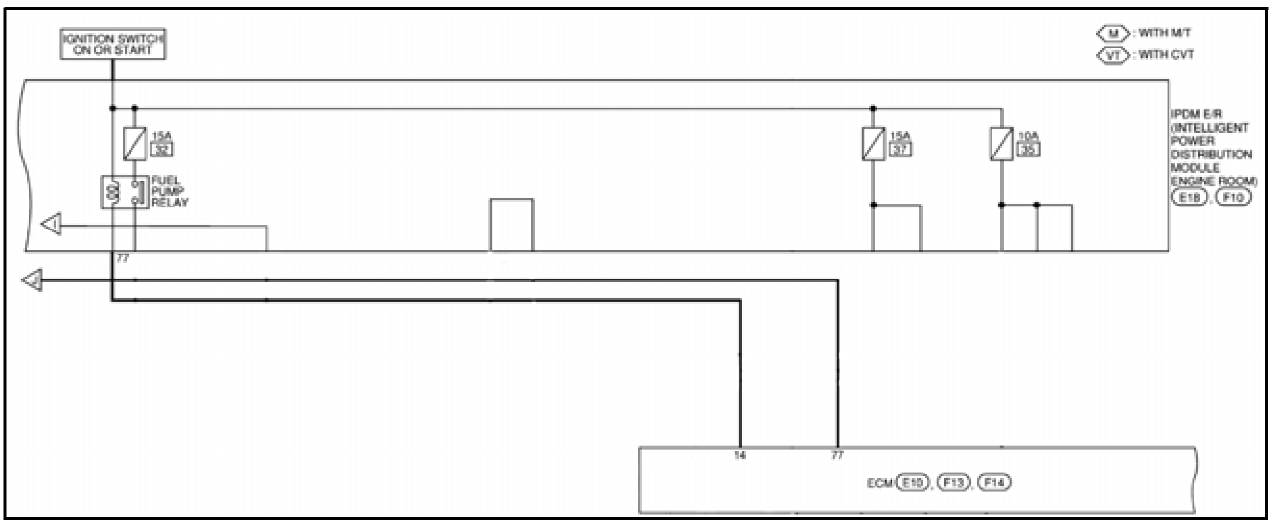
Description

SYSTEM DESCRIPTION

Sensor	Input Signal to ECM	ECM Function	Actuator
Crankshaft position sensor (POS) Camshaft position sensor (PHASE)	Engine speed	Fuel pump control	Fuel pump relay
Ignition switch	Start signal		

The ECM activates the fuel pump for several seconds after the ignition switch is turned on to improve engine startability. If the ECM receives a engine speed signal from the camshaft position sensor (PHASE), it knows that the engine is rotating, and causes the pump to operate. If the engine speed signal is not received when the ignition switch is ON, the engine stalls. The ECM stops pump operation and prevents battery discharging, thereby improving safety. The ECM does not directly drive the fuel pump. It controls the ON/OFF fuel pump relay, which in turn controls the fuel pump.

As long as the ECM senses engine speed, it will enable the fuel pump relay to remain energized. If the vehicle stalls, or is disabled in an accident, the ECM will disable the fuel pump relay.



This typical schematic shows the fuel pump relay inside the Intelligent Power Distribution Module (IPDM-ER). The ECM controls the fuel pump relay coil. The IPDM is located in the engine room (ER) and supplies power to many systems on the vehicle. Fuses in the IPDM-ER are serviceable, but the relays are not. The IPDM-ER must be replaced in the event of a relay failure.

Checking Fuel Pressure

The Symptom Chart in Nissan and Infiniti ESMs lists items to check in priority order based on the problem with the vehicle. In the event of a 'No - Start' condition, the fuel pump is one of the first items that should be checked.

Symptom Table

SYSTEM — BASIC ENGINE CONTROL SYSTEM

		SYMPTOM													
		HARD/NO START/RESTART (EXCP. HA)	ENGINE STALL	HESITATION/SURGING/FLAT SPOT	SPARK KNOCK/DETONATION	LACK OF POWER/POOR ACCELERATION	HIGH IDLE/LOW IDLE	ROUGH IDLE/HUNTING	IDLING VIBRATION	SLOW/NO RETURN TO IDLE	OVERHEATS/WATER TEMPERATURE HIGH	EXCESSIVE FUEL CONSUMPTION	EXCESSIVE OIL CONSUMPTION	BATTERY DEAD (UNDER CHARGE)	Reference page
Warranty symptom code		AA	AB	AC	AD	AE	AF	AG	AH	AJ	AK	AL	AM	HA	
Fuel	Fuel pump circuit	1	1	2	3	2		2	2			3		2	EC-455
	Fuel pressure regulator system	3	3	4	4	4	4	4	4	4		4			EC-542
	Fuel injector circuit	1	1	2	3	2		2	2			2			EC-452
	Evaporative emission system	3	3	4	4	4	4	4	4	4		4			EC-74
Air	Positive crankcase ventilation system	3	3	4	4	4	4	4	4	4		4	1		EC-472
	Incorrect idle speed adjustment						1	1	1	1		1			EC-12
	Electric throttle control actuator	1	1	2	3	3	2	2	2	2		2		2	EC-363, EC-370

The first test for the suggested in the ESM is to pinch the fuel delivery line and confirm that fuel flows through the line for about 1 second after the ignition is turned On. Remember that the fuel pump will only run for 1 second unless the ECM receives engine an RPM input signal.

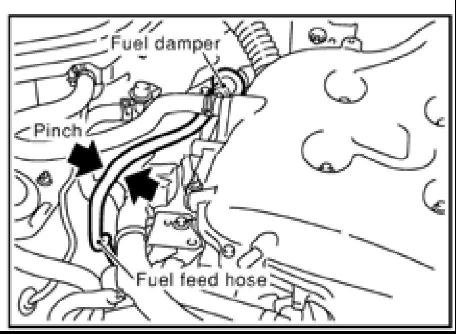
Diagnostic Procedure

1. CHECK OVERALL FUNCTION

1. Turn ignition switch ON.
2. Pinch fuel feed hose with two fingers.
   Fuel pressure pulsation should be felt on the fuel feed hose for 1 second after ignition switch is turned ON.

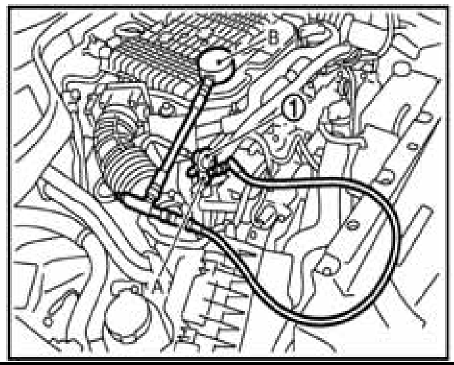
OK or NG

OK >> **INSPECTION END**
NG >> GO TO 2.



Checking fuel pressure is listed as a lower priority on the Symptom Chart. If the fuel pump is operating and other systems are checked for a ‘No - Start’ condition, eventually the fuel pressure would need to be inspected. Special Service Tool J-44321 is required for the quick disconnect fittings used on Nissan and Infiniti fuel manifolds.

1. Release fuel pressure to zero.
2. Install the inline fuel quick disconnected fitting (A) between fuel damper (1) and injector tube.
3. Connect the fuel pressure test gauge (quick connector adapter hose) (B) to the inline fuel quick disconnected fitting.
4. Turn ignition switch ON and check for fuel leakage.
5. Start engine and check for fuel leakage.
6. Read the indication of fuel pressure gauge.



At idling : Approximately 350 kPa (3.57 kg/cm^2, 51 psi)

The procedures for inspecting fuel pressure are detailed in the example above copied from an Infiniti ESM.

Fuel Injector Control

There are many input signals to the ECM to control the Fuel Injector pulse.

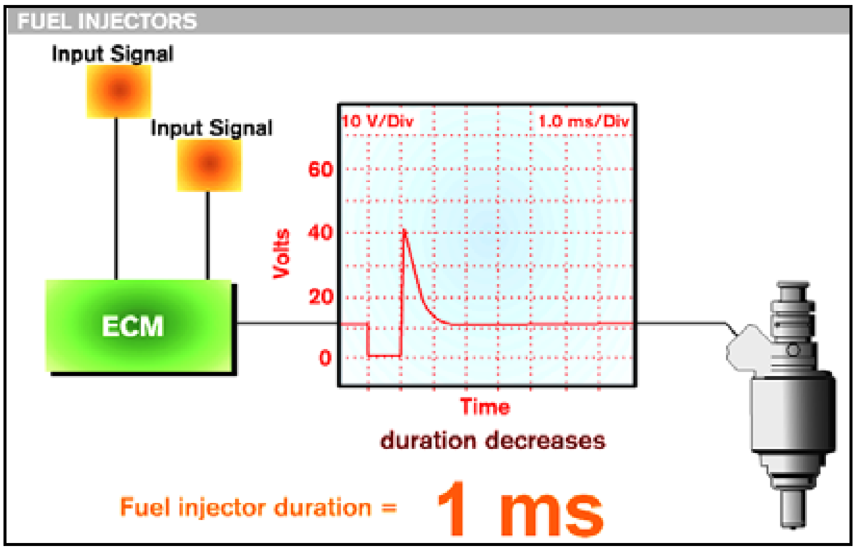
INPUT/OUTPUT SIGNAL CHART

Sensor	Input Signal to ECM	ECM function	Actuator
Crankshaft position sensor (POS)	Engine speed Piston position	Fuel injection & mixture ratio control	Fuel injectors
Camshaft position sensor (PHASE)			
Mass air flow sensor	Amount of intake air		
Engine coolant temperature sensor	Engine coolant temperature		
Heated oxygen sensor 1	Density of oxygen in exhaust gas		
Throttle position sensor	Throttle position		
Accelerator pedal position sensor	Accelerator pedal position		
Park/neutral position (PNP) switch	Gear position		
Ignition switch	Start signal		
Knock sensor	Engine knocking condition		
Battery	Battery voltage		
Power steering pressure sensor	Power steering operation		
Heated oxygen sensor 2 *1	Density of oxygen in exhaust gas		
ABS actuator and electric unit (control unit) *2	ABS/TCS operation command		
Air conditioner switch*2	Air conditioner operation		
Vehicle speed sensor*2	Vehicle speed		

*1: Under normal conditions, this sensor is not for engine control operation.
*2: Signals are sent to the ECM through CAN communication line.

In the sample chart above, these input signals are listed in priority order. POS and PHASE, in addition to the Mass Air Flow sensor are the most important ECM input signals to control the length of the fuel injector pulse.

The ECM controls the fuel injector by grounding the output circuit for a few milliseconds. Battery voltage powers the fuel injector and when the ECM supplies a ground, current flow creates a magnetic field in the injector coil. Pressurized fuel is then sprayed into the intake manifold.



The most accurate way to measure injector pulse is with an oscilloscope or CONSULT-III.

In this example, the ECM has grounded the output circuit for the fuel injector for 1 mSec. That is the amount of time that injector voltage remains at 0 volts.

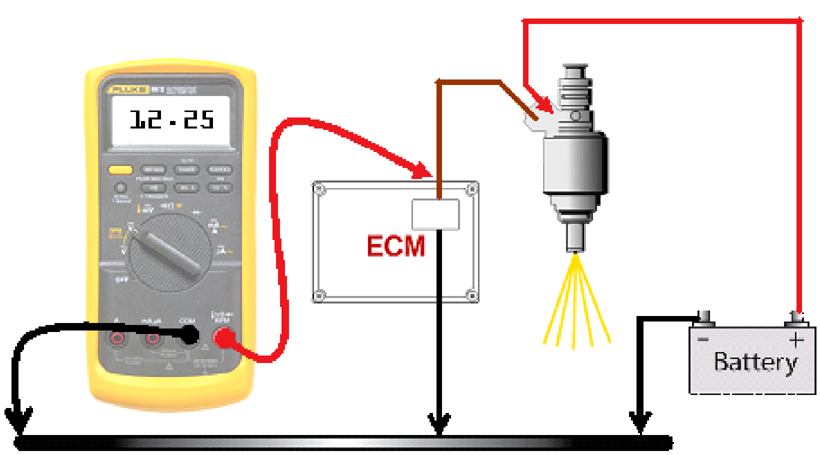
CONSULT-III can also be used to check the injector pulse width in Data Monitor.

The ESM indicates the 'Reference Value' for the injector pulse should be about 2 to 3 mSecs at idle speed when inspected with CONSULT-III. CONSULT-III will not show the pulse for each separate injector, but will list the pulse width the ECM is using for all the injectors or for each bank of the engine. An oscilloscope is the most effective way to check individual injectors.

ECCS controlled fuel injector circuits will not set a specific Diagnostic Trouble Code (DTC) if there is an electrical open or short in the circuit. DTCs for a 'Misfire' or 'Fuel System Lean' could be set, and these conditions will be reviewed later in this text.

The ESM recommends using a stethoscope to listen for the fuel injector to click when the engine is running. Voltage tests can also be used to confirm fuel injector operation.

The graphic below tests for a voltage drop across the injector while the engine is running.



The DVOM in this example is reading less than battery voltage with the engine running.

If the engine RPM is increased, voltage on the injector 'output' wire will drop as the ECM holds the injector open for a longer pulse.

It is typical for voltage to drop to between 8 and 11 volts under heavy acceleration.

Electronic Ignition (EI) System

The Electronic Ignition System uses most of the same input signals as the Fuel Injection Control system. Engine RPM, engine load, coolant temperature and throttle position all contribute to the timing of the spark.

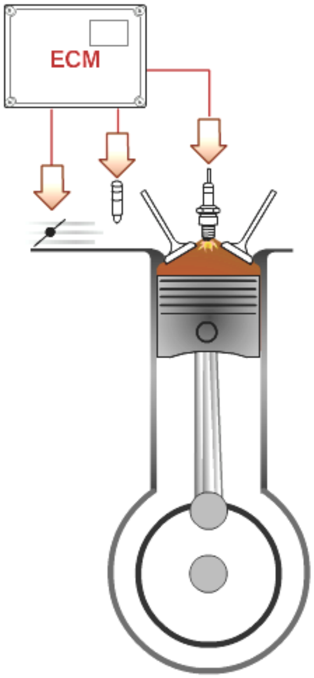
The ECCS system controls the timing of the spark to provide the engine with power during acceleration and maintain efficient combustion at idle speed.

Most Nissan and Infiniti vehicles have a specification of 15° to 18° before Top Dead Center at idle speed and 25° to 45° BTDC at 2000 RPM.

Nissan and Infiniti recommend ignition timing be checked with a timing light, and most models enable a small adjustment to advance or retard timing using the CONSULT-II or III diagnostic tool.

The Knock sensor is a critical input to the ECM. Ignition timing will be retarded if the knock sensor indicates that the engine has a pre-ignition or knocking problem.

Nissan and Infiniti Direct Ignition systems provide a power transistor for each cylinder's coil assembly, simplifying system operation and diagnostics.



Input signals controlling the Power Transistor are shown in this chart and are typical of most Nissan and Infiniti ignition systems. Inputs are listed in order of importance from top to bottom.

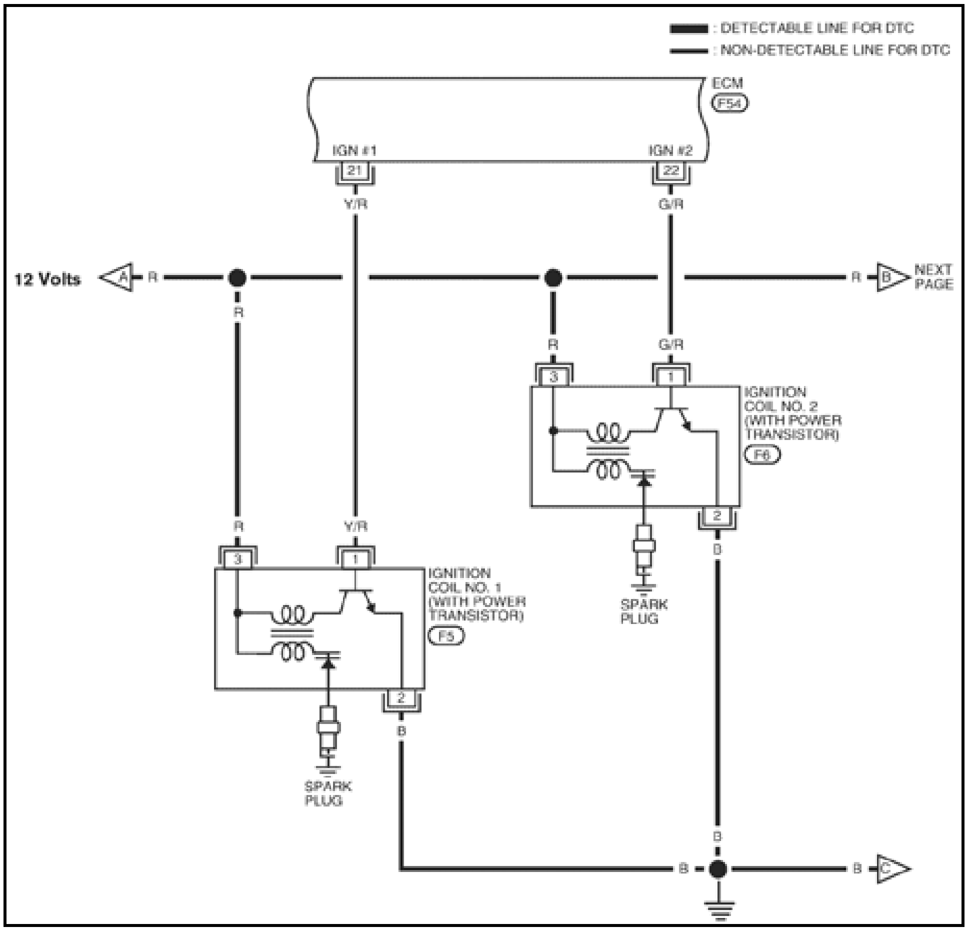
Note that Crankshaft and Camshaft position sensors are the most important Electronic Ignition inputs, providing engine speed and piston position information to control spark timing.

Electronic Ignition (EI) System
INPUT/OUTPUT SIGNAL CHART

Sensor	Input Signal to ECM	ECM function	Actuator
Crankshaft position sensor (POS)	Engine speed	Ignition timing control	Power transistor
Camshaft position sensor (PHASE)	Engine speed and piston position		
Mass air flow sensor	Amount of intake air		
Engine coolant temperature sensor	Engine coolant temperature		
Throttle position sensor	Throttle position		
Accelerator pedal position sensor	Accelerator pedal position		
Ignition switch	Start signal		
Knock sensor	Engine knocking		
Park/neutral position (PNP) switch	Gear position		
Battery	Battery voltage		
Vehicle speed sensor	Vehicle speed		

The Power Transistor is switched On and Off by the ECM.

Ignition System Operation



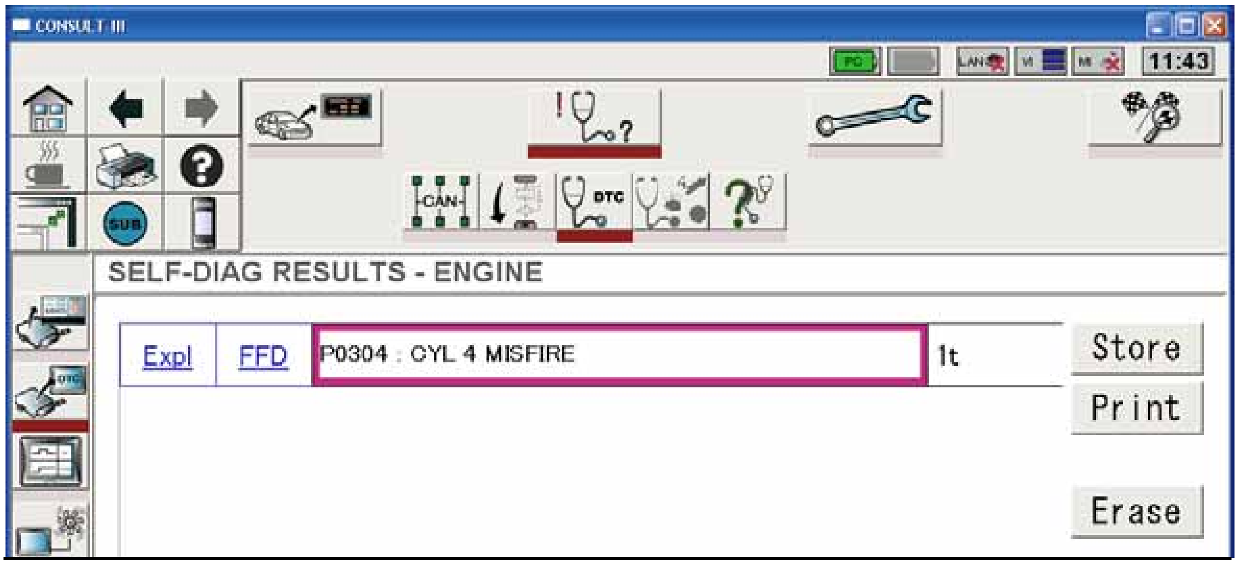
Nissan and Infiniti Direct Ignition Systems combine the Power Transistor and Ignition Coil into one component. In the typical system shown above:

- Battery voltage is supplied to the red (R) wire from the ECM relay when the ignition is On
- The red wire supplies 12 volts to the Primary winding in the coil
- Current will not energize the primary winding until the ECM sends a signal to the 'Base' of the Power Transistor - terminal #1 at the ignition coil (Y/R for coil #1, G/R for coil #2)
- When the ECM sends a signal to the power transistor, the transistor will switch the primary winding to ground, energizing the ignition coil
- A magnetic field is created in the coil as current flows through the primary winding
- The ECM will turn Off the base signal after a few milli-seconds, opening the primary circuit
- The magnetic field 'collapses' across the secondary coil winding, usually creating a 7000 to 15,000 (7 to 15KV) volt spark
- This voltage jumps across the spark plug gap to ground, creating the spark which ignites the air / fuel mixture

Ignition Misfire Diagnosis

If the Ignition System malfunctions, the engine could misfire. This condition could result in fuel from the misfiring cylinder getting into the exhaust system and catalytic converter. Too much fuel in the catalyst could destroy the converter and increase vehicle emissions.

The ECM detects misfires by monitoring crankshaft speed using the crankshaft position (POS) sensor. If one cylinder is not producing an increase in crankshaft speed, the ECM will set a diagnostic trouble code (DTC) identifying the misfiring cylinder.



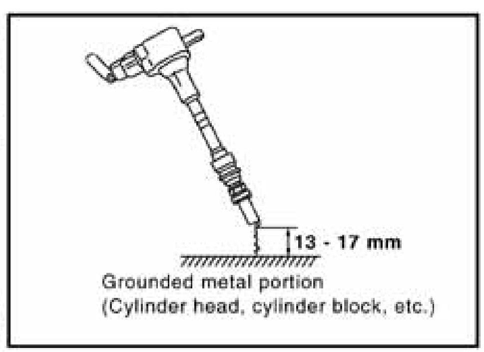
The DTC P0304 indicates that cylinder number 4 is misfiring. The ESM will provide a diagnostic procedure that will enable technicians to isolate the problem. The ESM demonstrates checking for spark by confirming the coil is strong enough to produce a spark capable of jumping an air gap between 13 and 17 millimeters long.

Fix ignition coil using a rope etc. with gap of 13 - 17 mm between the edge of the spark plug and grounded metal portion as shown in the figure.
Crank engine for about 3 seconds, and check whether spark is generated between the spark plug and the grounded metal portion.

Spark should be generated.

CAUTION:

- **Do not approach to the spark plug and the ignition coil within 50cm. Be careful not to get an electrical shock while checking, because the electrical discharge voltage becomes 20kV or more.**



Ignition System 'No Spark' Diagnosis

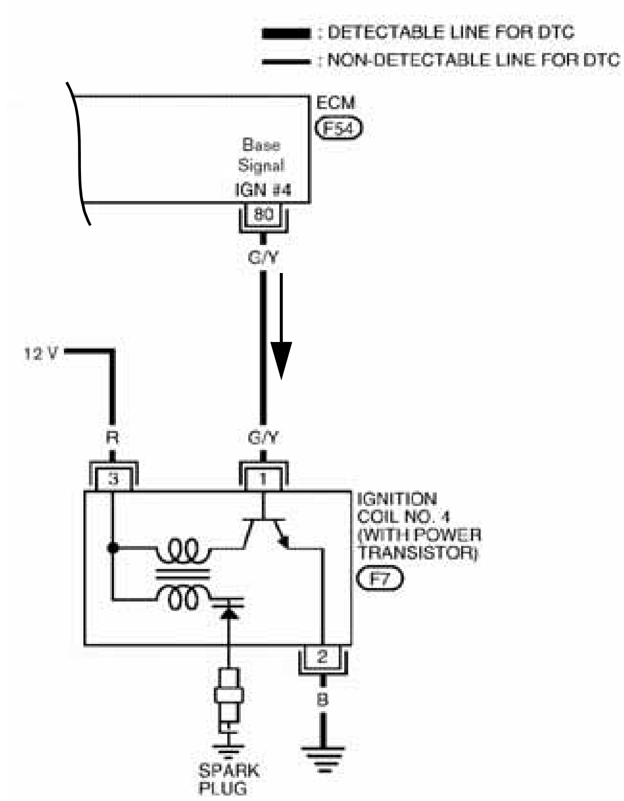
Ignition Coil circuit failures will not set a specific DTC, but a Misfire DTC will set if the coil is not providing a spark.

The 12V Power Supply to the coil must be confirmed when the ignition is 'On'.

When the POS and PHASE (crankshaft and camshaft position) sensors provide input to the ECM, the ECM will send a signal to terminal #1 of the coil.

The 'Base' signal should be confirmed using an oscilloscope. Using the CONSULT-III Measurement Interface is a good way to check for this signal.

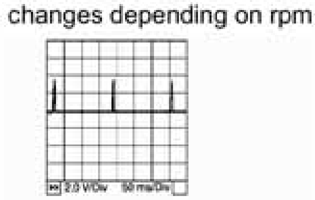
The coils must have a good ground. Tech Line reports that negative battery cables and 'F' harness grounds should be inspected, changed or repaired if ground voltage drop exceeds 50 milli-volts. (0.05V)

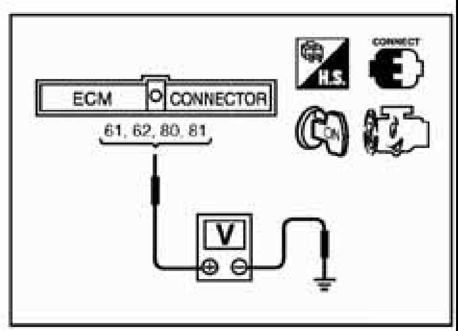


The Power Transistor is an electronic 'switch'. When there no voltage signal at the base (terminal #1 at the coil shown previously), the 'switch' is open and current will not flow through the coil primary winding. When the ECM sends voltage to the transistor base, the 'switch' will close and current will flow. The transistor circuit closes and opens very quickly, so testing with a voltmeter is not recommended. In this graphic, you see how the ESM recommends confirming the base signal.

1. Let engine idle.
2. Read the voltage signal between ECM terminals 61, 62, 80, 81 and ground with an oscilloscope.
3. Verify that the oscilloscope screen shows the signal wave as shown below.

   NOTE:
   The pulse cycle changes depending on rpm at idle.





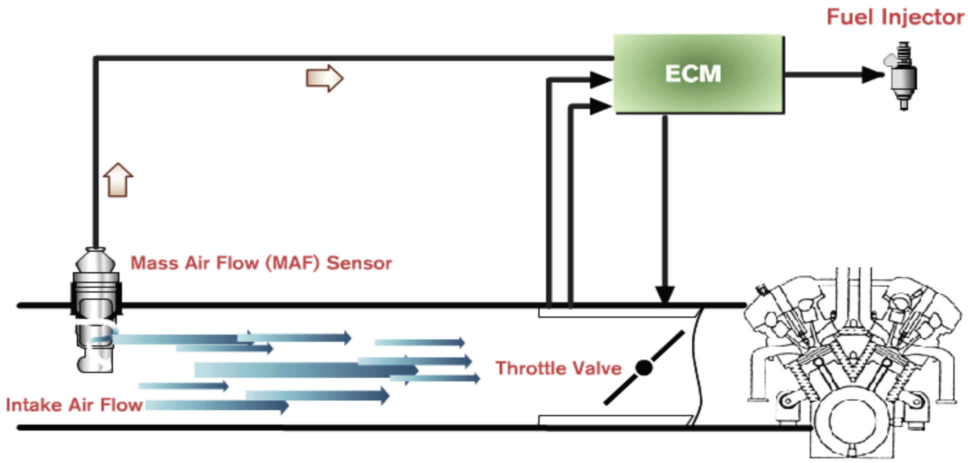
If a cylinder has no spark at the coil, this test is necessary to confirm that the ECM is sending a pulse signal to the base of the Power Transistor.

Air Flow Control

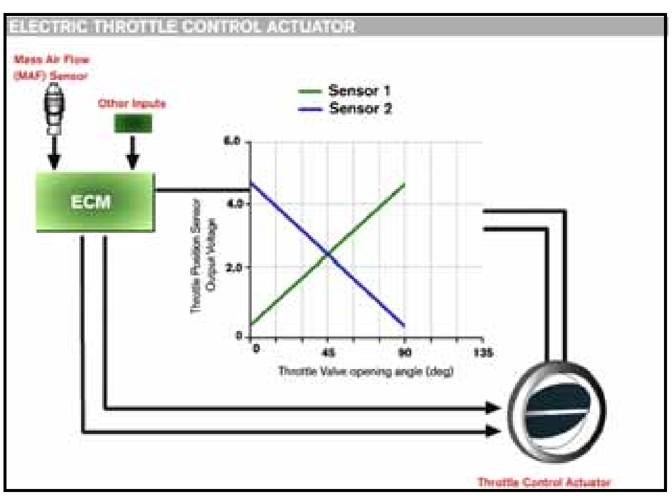
All internal combustion engines require an air / fuel mixture, a spark and engine compression to support combustion. Nissan and Infiniti ECMs control fuel pump and fuel injector operation based on inputs from critical sensors. The ECM uses many of the same sensor inputs to control ignition timing.

Nissan and Infiniti vehicles control air flow into the engine through an Electric Throttle Controller (ETC). The ETC system replaced cable controlled throttle valves for most Nissan and Infiniti models in the 2002 model year.

An Accelerator Pedal Position (APP) sensor signals the ECU that more throttle opening is requested, and the ECU operates an electric motor to open the throttle. The Mass Air Flow sensor measures the amount of air entering the engine and the fuel injection pulse is adjusted as necessary. The Mass Air Flow sensor provides an input signal indicating engine load, and is critical for good vehicle driveability and efficient combustion.



Nissan and Infiniti vehicles will set a DTC if the Mass Air Flow sensor has an open or short circuit. Late models will also set a code for Mass Air Flow if sensor input voltage is too high or low based on the engine load conditions.



The ECM controls the Electric Throttle Controller based on input from the accelerator pedal position sensor.

Sensors 1 & 2 provide the ECU with feedback regarding the position of the throttle valve.

Vehicles equipped with Traction Control use ‘slip’ indications from wheel speed sensor input to regulate throttle position and control engine torque.

Testing Engine Control Components

Troubleshooting the ECCS system requires the use of CONSULT-III, a digital volt / ohm meter (DVOM), and an Oscilloscope. To use these tools effectively, technicians must have experience testing circuits for power supply, resistance, continuity and voltage drops.

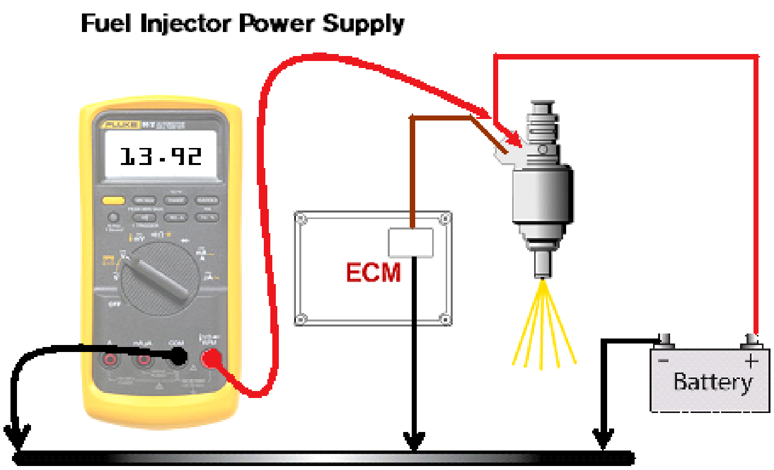
This section of the text will provide a review of some of basic ECCS Component electrical inspections.

Power Supply

A digital Volt/Ohm meter should always be used when testing ECCS circuits.

In this example, the meter is set to DC Volts and is measuring the power supply available to the fuel injector with the engine running.

In this simplified picture, the ignition switch is not shown and the meter indicates battery voltage.



Most Nissan and Infiniti vehicles supply battery voltage to each fuel injector through the ignition switch and a fuse. Each injector should have battery voltage available on the power supply wire with the ignition On or the engine running.

The power supply for some ECCS components is battery voltage. Mass Air Flow sensors, Fuel Injectors and Ignition Coils all use 12V power supplies on Nissan and Infiniti ECCS systems.

Sensor Testing

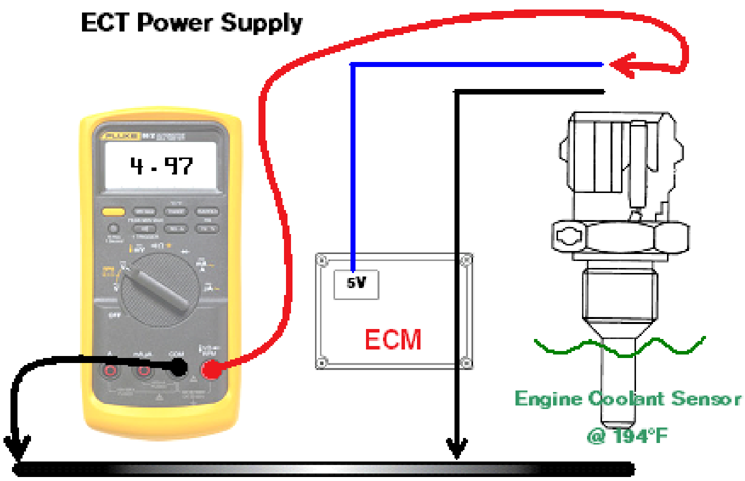
Many input sensors are powered by 5 volts. The ECM supplies this 5 volt signal for the Coolant Temperature sensor, Accelerator Pedal Position sensor, Crankshaft Position sensors and many others.

The ignition switch (not shown) is On, and the Engine Coolant sensor is unplugged.

The positive lead of the DVOM is connected to the power supply wire for the sensor.

The meter indicates 4.97 volts, which is within acceptable limits.

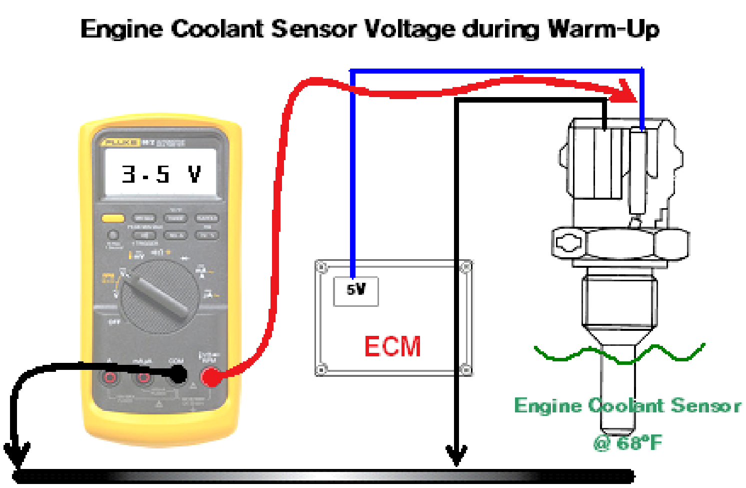
The ECM supplies a 5 volt signal so that changes in battery voltage will not affect sensor performance.



In the example shown above, the coolant sensor is grounded through he ECM. The sensor has high resistance when the coolant is cold, and sensor resistance drops as the coolant temperature increases.

This type of sensor is called a negative temperature coefficient or NTC sensor. The 5 volts supplied by the ECM will drop as the coolant sensor gets hotter. If the connector is unplugged, the DVOM should always indicate about 5 volts. Once the sensor is plugged in, voltage will drop based on coolant temperature.

Input Voltage



The coolant sensor connector is plugged back in, and the coolant is about 68 degrees F.

The 5 volt power supply drops to about 3.5 volts as current flows through the sensor to ground.

The ECM provides specifications for ECT sensor voltage based on the actual coolant temperature.

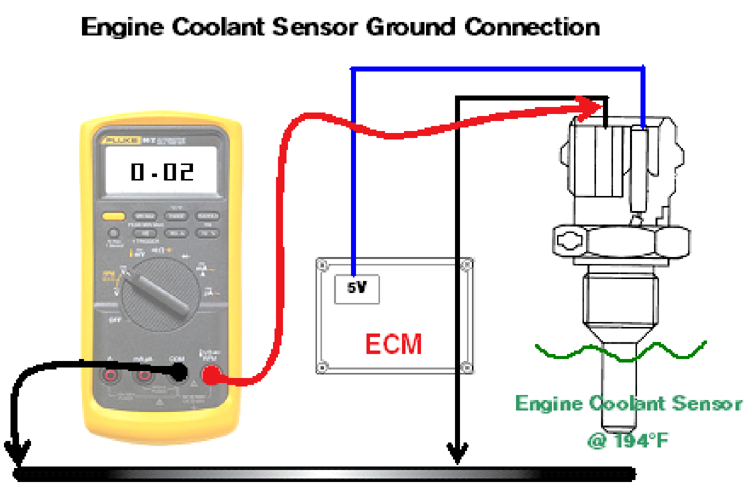
The voltage on the ground wire should never change. Nissan and Infiniti ESMs recommend that ground connections for sensors measure less than 0.1 volts. If there is a poor connection, or corrosion between the coolant sensor ground wire and the chassis, the DVOM may indicate more than 0.1 volts when testing for voltage drop. Excessive voltage drop will change the input voltage reading at the ECM and could affect driveability.

The ignition is turned On, and the DVOM is connected to the ground wire for the coolant sensor.

The reading of 0.02 volts indicates a good ground connection.

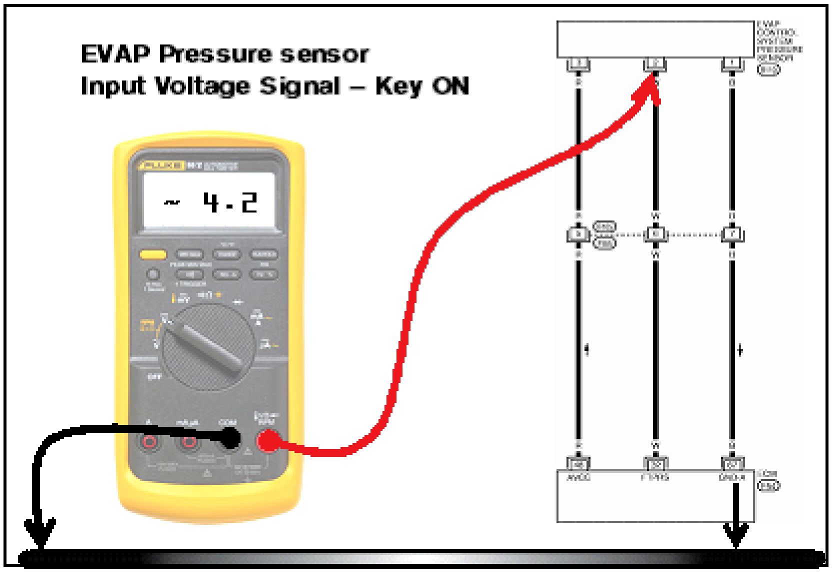
The ESM will recommend either resistance or voltage drop inspections to check ground circuits.

Voltage drop inspections are considered to be more accurate.



NOTE: The voltage drop reading above of 0.02 volts or 20 millivolts indicates a good ground connection. Most sensors should have a ground side voltage drop of 0.02 to 0.04 (20 to 40 millivolts) or less.

Power Supply and Input Voltage, 3 Wire sensors



There are many sensors that operate on a 5 volt Power Supply. The AVCC terminal at the ECM supplies a constant 5 volt signal to this EVAP Pressure sensor.

The sensor Input Signal (FTPRS) will vary from 1.8 to 4.8 volts depending on pressure in the evaporative system.

Approximately 4.2 volts is a normal reading with the Key On and the Engine Off at sea level.

The EVAP Pressure sensor shown above is a good example of a typical 3 wire sensor used on Nissan and Infiniti ECCS systems. The first step in ECM diagnostics is to inspect the ground circuit for the sensor. The voltage drop on the black wire at terminal 1 of the pressure sensor should be 0.1 volt or less - just as indicated for the coolant sensor ground connection.

The next test would be to confirm the power supply is approximately 5 volts.

The input signal is the last test for the pressure sensor. This voltage will vary based on EVAP pressure. The ESM recommends testing for about 4.2 volts with the key On and engine Off. This voltage will vary based on atmospheric pressure.

If you apply about 7 - 8” HG vacuum, the voltage should drop to between 2.1 and 2.5 volts.

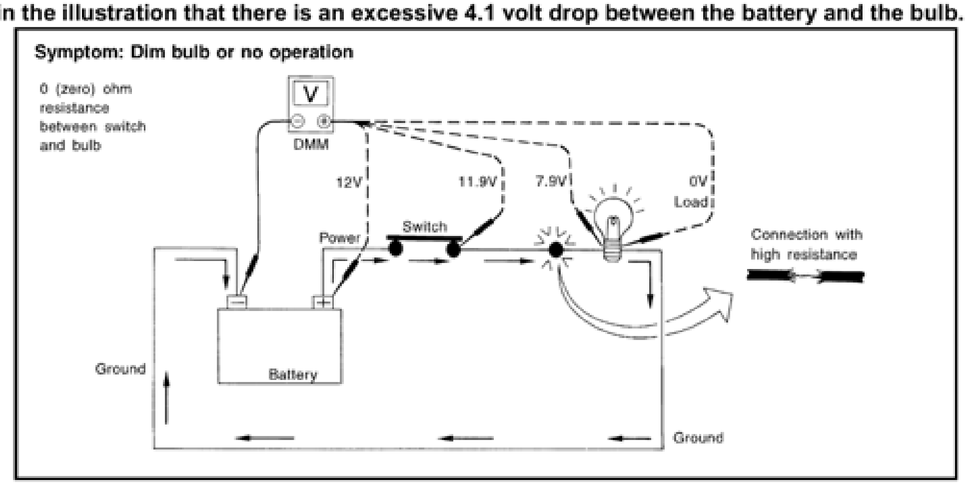
General Information - Testing Electrical Circuits

The General Information section of the ESM provides instructions for basic circuit testing procedures.

ECCS circuits should always be tested with a digital Volt / Ohm meter. These meters features higher internal resistance than analog style testers. Many ECCS circuits use very small amounts of current between input sensors and vehicle computers. Analog testers may effect these circuits by allowing too much current to flow in the circuit when testing the system. Test lights should never be used when testing ECCS circuits because they allow much more current flow than digital multi meters. Using a test lamp to test an ECCS circuit could easily damage the ECM.

In the graphic below copied from the ESM, note the reference to voltage drop testing when troubleshooting a problem with a lighting circuit.

Note in the illustration that there is an excessive 4.1 volt drop between the battery and the bulb.

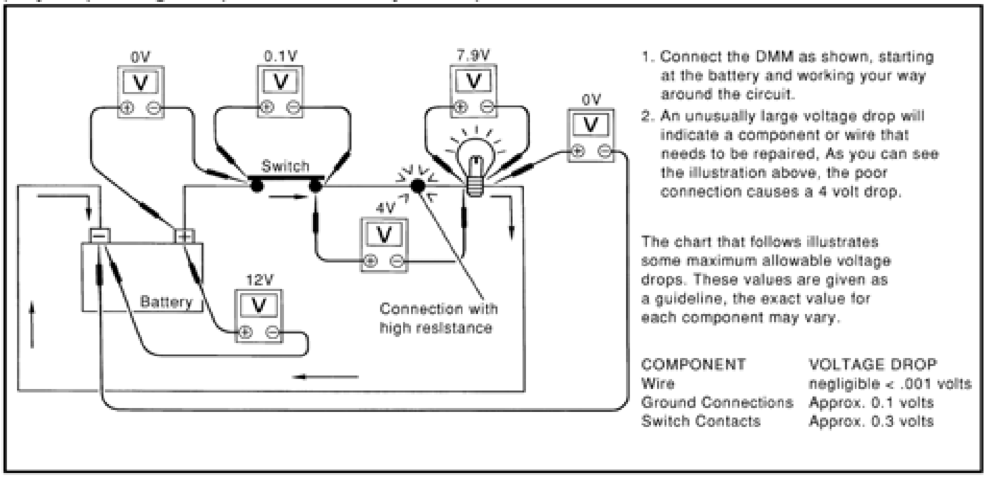


- The DMM (digital multi meter) indicates the 'Power Supply' voltage at the light bulb is 7.9 volts and the reading should be about the same as battery voltage.
- 11.9 volts are available after the switch is closed.
- The frayed wire creates high resistance. There is less actual wire available for current to flow, and the circuit problem causes an excessive voltage drop.
- In this example, an ohmmeter would indicate that this wire is OK, because it does have continuity.
- The voltage test indicates that the problem is between the switch and the bulb, and in this example the excessive voltage drop causes the bulb to glow dimly.

NOTE: Remember that in ECCS circuits the power supply could be 12v or 5v. In either case, testing voltage in various points in the circuit is the best way to find the cause of excessive voltage drop.

In the graphic below, the DMM is connected to pinpoint the wire causing the voltage drop.

The step by step voltage drop test can identify a component or wire with too much resistance.



- The battery has 12 volts available.
- The ground circuit, the wire to the switch and the switch itself use very little voltage. The graphic indicates specifications for allowable voltage drops for these parts of the circuit.
- The wire going from the switch to the lamp is ‘using’ or dropping 4.1 volts.
- Wires and switches in a circuit should use little or no voltage.
- Due to this high resistance connection, only 7.9 volts are available for the lamp.

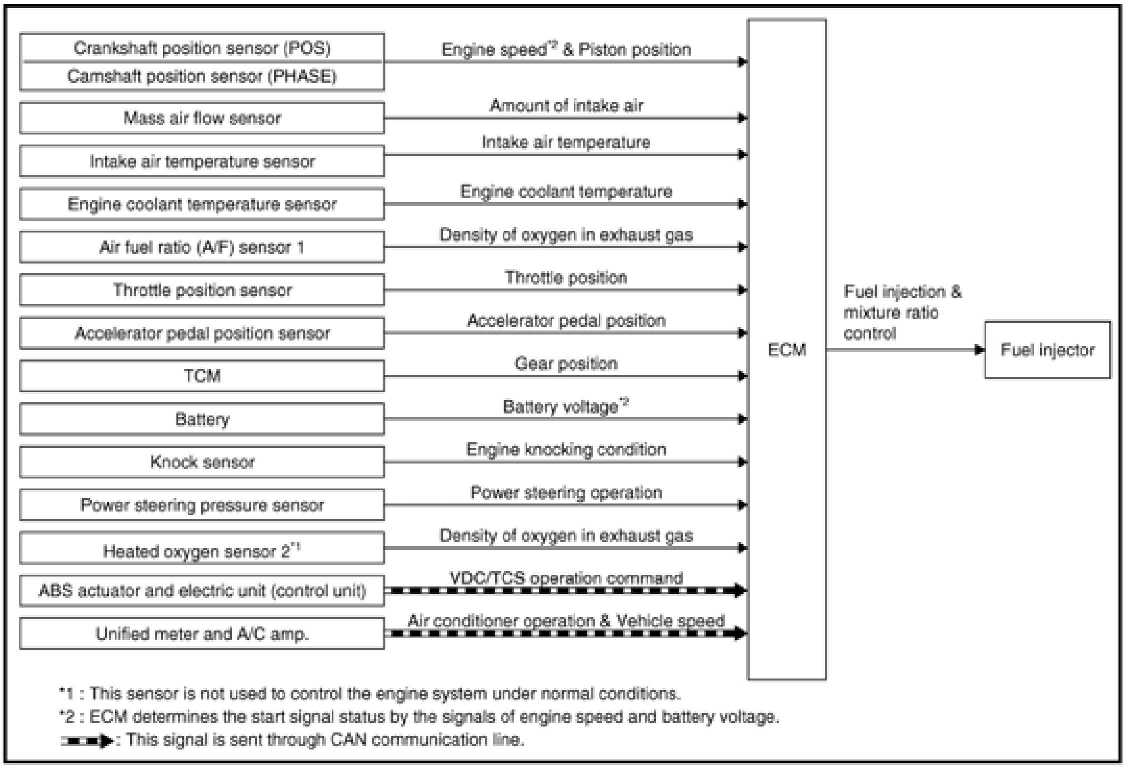
The General Information (GI) section of the ESM provides information about reading Nissan and Infiniti wiring diagrams, interpreting symbols used in the ESM and how harness and connectors can be located in the vehicle.

The following resources can also be used to learn more about performing electrical tests on Nissan and Infiniti vehicles:

- Introduction to Electrical Components: ELTC9903A - On Line training is available in Virtual Academy
- SIR 139: Diagnosing Electrical Systems
- SIR 127: CAN Diagnosis
- SIR Nissan volume 87, Infiniti volume 67: Electrical Circuit Diagnosis

Mixture Feedback Control

The ECM controls the air fuel mixture by adjusting injector pulse duration based on input information from a host of sensors.



The chart above is typical of Nissan and Infiniti ECCS input signals that effect the fuel injector pulse.

- The Crankshaft Position sensor (POS) and Camshaft Phase sensor (PHASE) provide the ECM with engine speed signals and piston position information. This is the most important input signal to control injector pulse width.
- The Mass Air Flow sensor is the second most important input signal controlling the injector. The ECM uses MAF input voltage to determine the engine load based on the quantity of air entering the intake manifold.
- The Engine Coolant Temperature sensor (ECT) provides an input signal that causes the ECM to enrich the mixture when the engine is cold and leans the mixture by signalling the ECM as the engine warms up.
- The Air Fuel (A/F) sensors send input voltage to the ECM based on the combustion gasses measured in the exhaust system. If the exhaust gasses indicate the injector pulse is too rich or too lean, the ECM will compensate. This is normally called ‘Feedback Control’.

- The Throttle Position (TPS) and Accelerator Pedal Position sensors provide the ECM with input information to control the mixture during acceleration and deceleration. Nissan and Infiniti vehicles all use Electronic Throttle Controls.
- The Accelerator Pedal Position sensor (APP) indicates the drivers request for more or less throttle opening and the Throttle Position sensors indicate where the ECM has positioned the throttle plate.

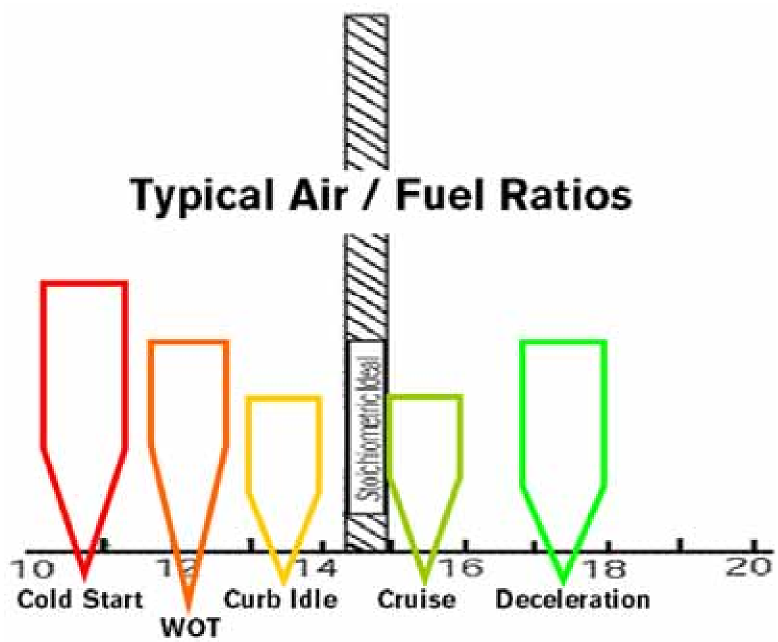
The remaining sensors contribute the mixture control, but the sensors listed above are the most critical inputs to the ECM to control the air fuel mixture, and they are the sensors we will focus on in this text.

The chart indicates how the ECM adjust the mixture based on some of the input signals listed.

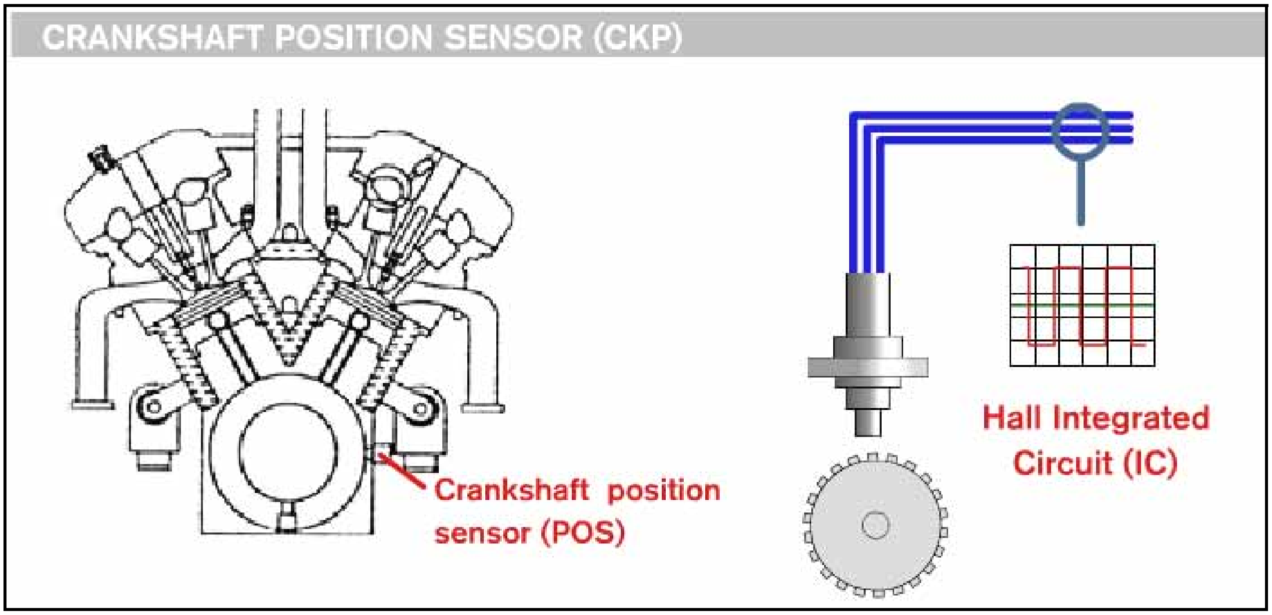
The ECT signal will cause the ECM to richen the mixture during cold start, and the TPS will affect the mixture during acceleration and on deceleration.

When the engine is warm, the A/F sensors will adjust the mixture close to the ideal point of 14.7 parts air to 1 part fuel.

ECCS controls enable the engine to both produce power and limit emissions based on these input signals.



Crankshaft Position and Camshaft Phase Sensors



The Crankshaft Position (POS) and Camshaft Position (PHASE) sensors generate a digital signal to the ECM that increases in frequency as engine speed increases. The injector pulses must also increase in frequency to supply the required amount of fuel. The increase in injector pulses is controlled primarily by the engine speed signal provided by the POS sensor.

The PHASE sensor signal provided by the camshaft (s) enables the ECM to control the timing of the injector pulse. Under most driving conditions, the ECM times the opening of the fuel injector to provide fuel at the best time to produce power and control emissions.

If either one of these sensors fail, the other sensor will provide the basic engine speed input signal that the ECM needs to keep the engine running.

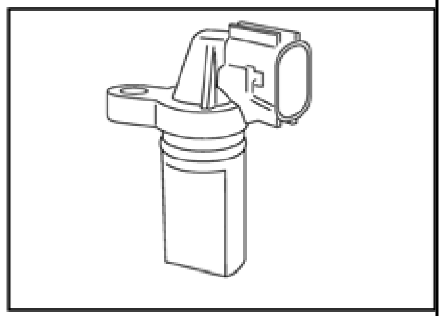
Ignition Timing, Idle speed, OBD II diagnostics and the Evaporative system are just some of the functions affected by the engine speed input signal provided by these sensors.

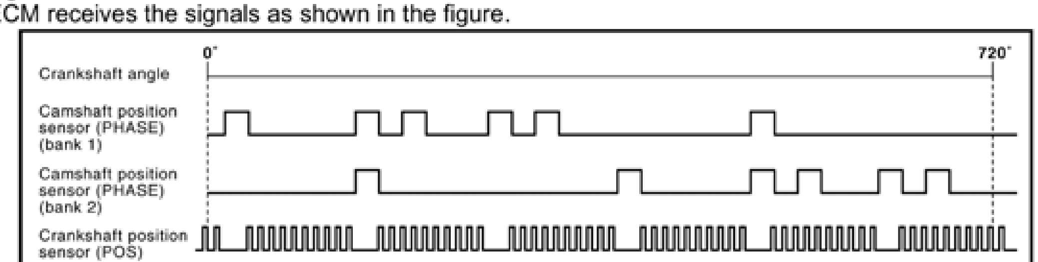
The graphic below is typical of V6 engine crankshaft and camshaft signals. The crankshaft flywheel has slots or 'teeth'. As these teeth pass by the permanent magnet of the crankshaft position sensor (POS), the sensor sends a signal to the ECM indicating engine RPM. The wider slots shown in the graphic reference piston position for each cylinder.

DTC P0335 CKP SENSOR (POS)

Component Description

The crankshaft position sensor (POS) is located on the oil pan facing the gear teeth (cogs) of the signal plate. It detects the fluctuation of the engine revolution.
The sensor consists of a permanent magnet and Hall IC.
When the engine is running, the high and low parts of the teeth cause the gap with the sensor to change.
The changing gap causes the magnetic field near the sensor to change.
Due to the changing magnetic field, the voltage from the sensor changes.
The ECM receives the voltage signal and detects the fluctuation of the engine revolution.
The ECM receives the signals as shown in the figure.





NOTE: Camshaft position sensor (PHASE) signal timing varies with intake valve timing control.

The camshafts also have teeth to represent the position of the piston for each cylinder. The camshaft position sensors (PHASE) send a signal to the ECM so that both fuel and spark can be provided to each cylinder at the ideal time.

The ECM will provide sequential fuel injection under normal conditions. Signals from the PHASE sensors will identify the position of each piston, and the fuel injectors will open at different times for each cylinder to provide fuel at the ideal moment of the intake stroke.

Simultaneous injection will occur when the engine is first started and if the ECM is in 'Fail Safe'. Under these conditions, all the injectors will open at the same time to insure that each cylinder has adequate fuel to support combustion.

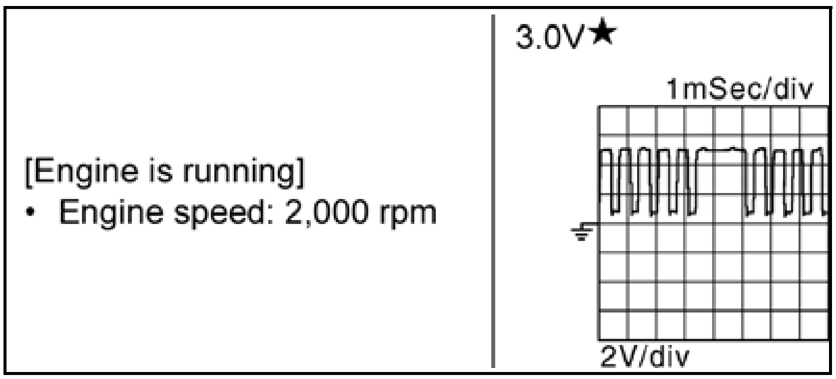
POS and PHASE Sensor Troubleshooting

Diagnostic Trouble Codes (DTCs) for crankshaft and camshaft sensors will set if there is an open or short in the circuit. The CKP sensor will usually set a P0335 DTC and the Camshaft sensors will set P0340 for Bank 1 and P0345 for Bank 2.

Each sensor can provide engine speed input information to the ECM. If one of these sensors fails, ECCS controls operate in 'Fail Safe' based on information from the other sensors.

Nissan and Infiniti POS and PHASE sensors used a 12V power supply from the IPDM-ER on most models through the 2006 model year. Most 2007 and newer models use a 5 volt power supply from the ECM.

The permanent magnet sensors each supply a digital signal that increases frequency as the engine RPM increases.



In this example, a POS sensor oscilloscope pattern from the ESM is illustrated.

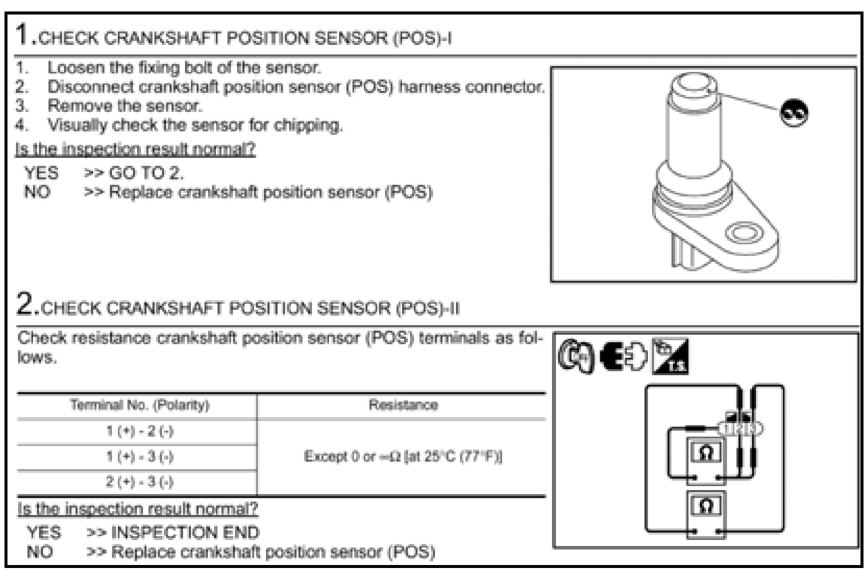
The signal cycles from 0 to about 5 volts. The 3V reference indicates that if the POS signal were measured with a DVOM, the meter would read a 3V average.

The ESM provides instructions for inspecting crankshaft or camshaft position sensors. A typical procedure for this inspection is shown in the graphic below. Nissan TSB NTB06-055 describes a procedure for using a special tool to 'deburr' the CKP sensor flywheel. This tool was required for 2006 350Zs with a manual transmission that set a P0335 DTC.

The condition of the sensor and flywheel should be checked with a visual inspection.

The sensor can be tested for resistance. In the test shown, the ohmmeter should indicate a number of ohms when tested.

If the meter indicates '0' ohms or 'OL' (over limit), the sensor should be replaced.



1.CHECK CRANKSHAFT POSITION SENSOR (POS)-I

1. Loosen the fixing bolt of the sensor.
2. Disconnect crankshaft position sensor (POS) harness connector.
3. Remove the sensor.
4. Visually check the sensor for chipping.

Is the inspection result normal?

YES >> GO TO 2.
NO >> Replace crankshaft position sensor (POS)

2.CHECK CRANKSHAFT POSITION SENSOR (POS)-II

Check resistance crankshaft position sensor (POS) terminals as follows.

Terminal No. (Polarity)	Resistance
1 (+) - 2 (-)	Except 0 or ∞Ω [at 25°C (77°F)]
1 (+) - 3 (-)	
2 (+) - 3 (-)	

Is the inspection result normal?

YES >> INSPECTION END
NO >> Replace crankshaft position sensor (POS)

Mass Air Flow Sensor

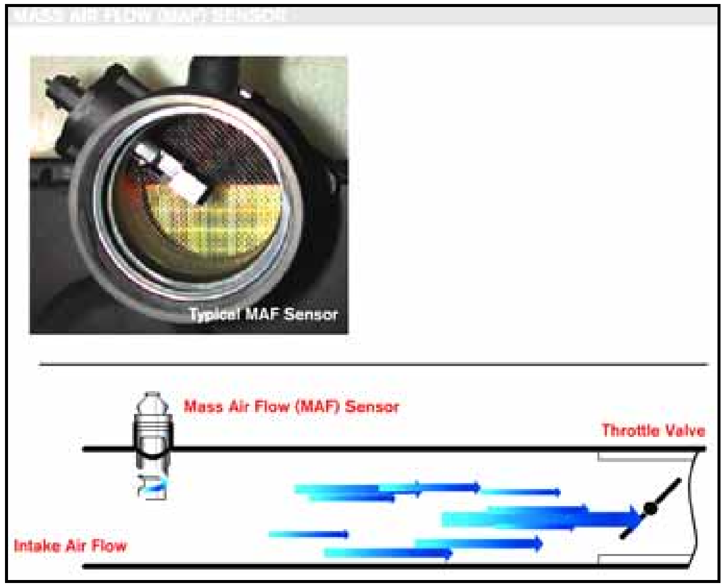
The Mass Air Flow (MAF) sensor samples a volume of air in the intake manifold. The ECM determines the proper injection pulse width based primarily on engine speed and MAF input voltage.

Nissan and Infiniti MAF sensors are either hot wire or hot film sensors.

The ECM maintains the wire temperature by sending current through the wire. As increased air flow cools the wire faster - the ECM increases current flow to maintain the wire's temperature.

As current flow from the ECM increases, the injector pulse is lengthened.

The MAF sensor input voltage relates to engine load, the greater the voltage the greater the loads on the engine.



Mass Air Flow Data Monitor

CONSULT-II Reference Value in Data Monitor Mode

Specification data are reference values.

MONITOR ITEM	CONDITION		SPECIFICATION
MAS A/F SE-B1	• Engine: After warming up • Air conditioner switch: OFF • Shift lever: N (A/T), Neutral (M/T) • No load	Idle	Approx. 1.1 - 1.5V
		2,500 rpm	Approx. 1.6 - 2.4V
CAL/LD VALUE	• Engine: After warming up • Shift lever: N (A/T), Neutral (M/T) • Air conditioner switch: OFF • No load	Idle	5% - 35%
		2,500 rpm	5% - 35%
MASS AIRFLOW	• Engine: After warming up • Shift lever: N (A/T), Neutral (M/T) • Air conditioner switch: OFF • No load	Idle	2.0 - 6.0 g·m/s
		2,500 rpm	7.0 - 20.0 g·m/s

The chart above displays typical values for the Mass Air Flow sensor when monitored with CONSULT-II or III.

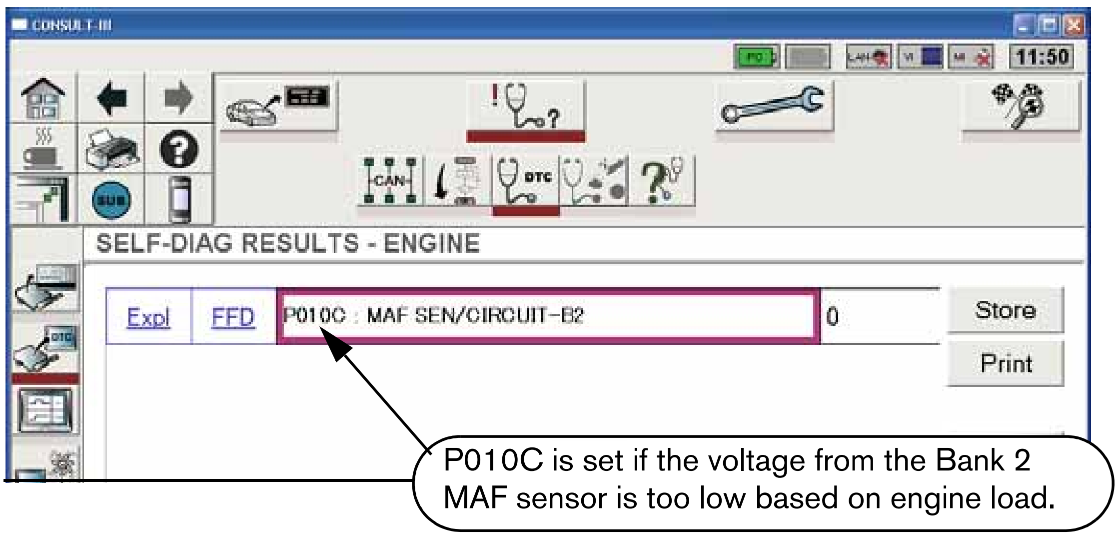
MASS AIRFLOW is a calculation of the volume of air being drawn into the intake manifold in grams per milli-second.

Mass Air Flow Sensor Troubleshooting

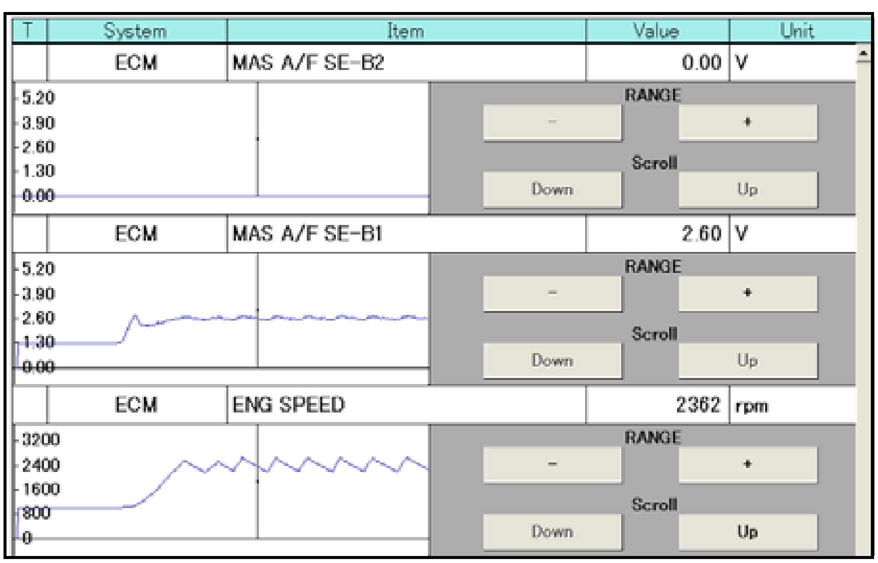
CONSULT-III can record several possible DTCs for the Mass Air Flow sensor. If the voltage from the sensor is too low when the engine is under a heavy load, or if the voltage is too high when loads on the engine are light - the ECM will set P0101.

If the MAF sensor has an electrical short circuit, or input voltage is close to 0 volts, the ECM will set P0102. If the input voltage is too high, indicating an electrically open circuit the ECM will set P0103.

P0101 is a 'rationality' type DTC, indicating that the sensor circuit is neither open or shorted, but the voltage from the sensor does not match input information from other sensors such as the throttle sensor and crankshaft position sensor.



The sample Data Monitor screen below displays the performance of the Bank 2 sensor that set the P010C DTC. This code was set on a vehicle with a MAF sensor for each bank.



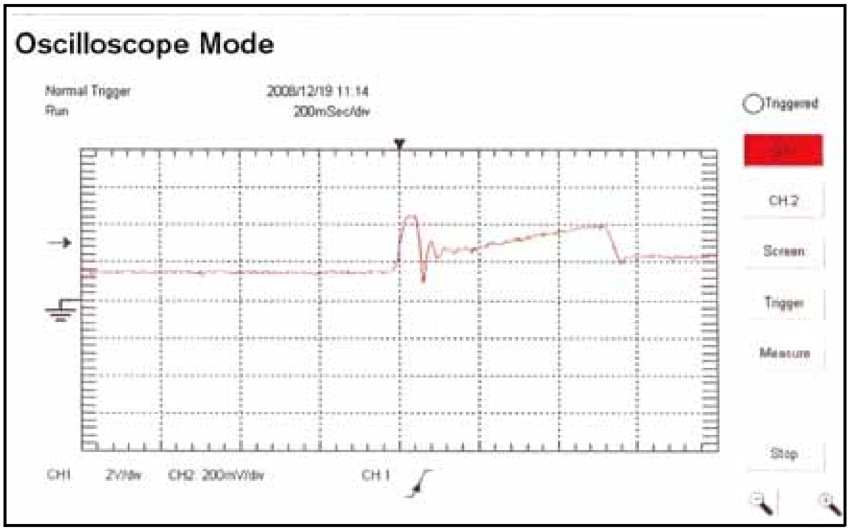
The MAF input voltage for Bank 1 is 2.60 volts.

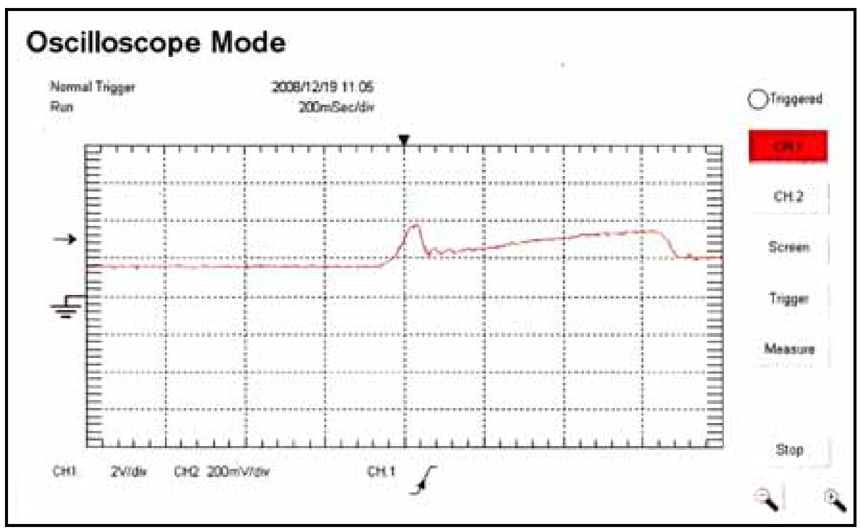
The Bank 2 MAF is unplugged and the input voltage is 0.

The ENG SPEED indicates the RPM is surging between about 2100 and 2400.

This is a 'Fail Safe' condition. The ECM limits RPM to 2400 using fuel cut to protect the engine

In addition to the DTCs that the MAF could set, the ESM lists typical oscilloscope patterns for the Mass Air Flow sensor. If the vehicle has set a MAF DTC, but the code cannot be confirmed in the shop, the ESM instructs technicians to graph the Mass Air Flow sensor while opening the throttle.





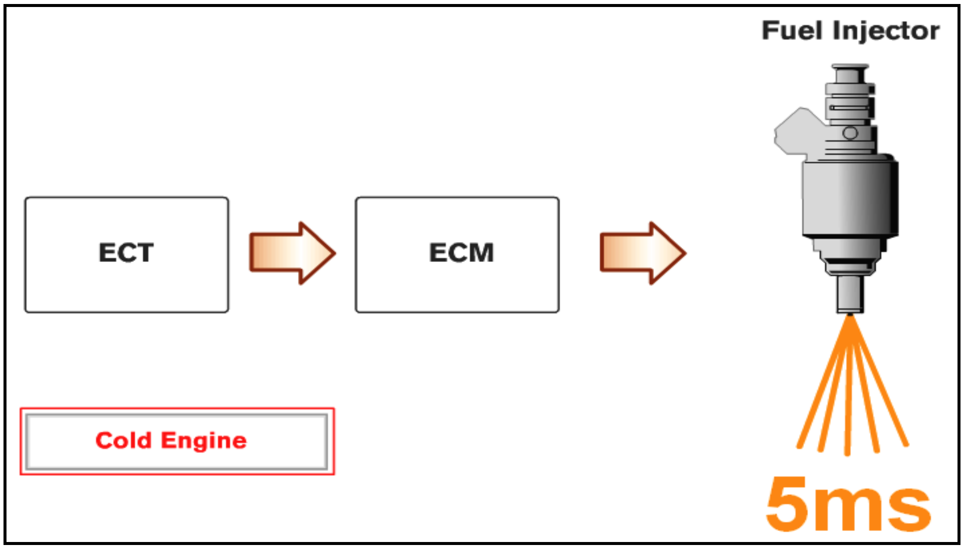
In the example shown above, the first Mass Air Flow pattern displays a MAF sensor that is responding properly as the throttle is opened quickly.

The second pattern is from a Mass Air Flow sensor that is faulty. This vehicle did not set a DTC, but would occasionally stall when coming to a stop.

Refer to Nissan Technical Bulletin NTB05-080a or Infiniti ITB05-051a for procedures to service a vehicle with a Mass Air Flow sensor DTC. The bulletin stresses cleaning the air filter housing and replacing the filter with a genuine Nissan air filter. The condition of the filter and housing can affect Mass Air Flow sensor voltage and potentially increase emissions or cause driveability concerns.

Engine Coolant Temperature Sensor

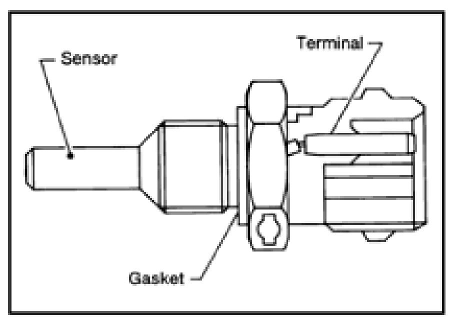
The Engine Coolant Temperature sensor input enables the ECM to control driveability and emissions during warm up. This sensor controls the injector pulse duration during warm up to insure the air / fuel mixture is rich enough to insure good driveability. ECT input also helps the ECM control ignition timing, the feedback control system and many evaporative system functions.



A description of the Coolant sensor, and typical voltage and resistance values are shown in the chart below.

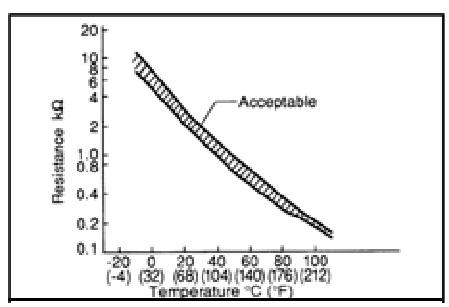
Description

The engine coolant temperature sensor is used to detect the engine coolant temperature. The sensor modifies a voltage signal from the ECM. The modified signal returns to the ECM as the engine coolant temperature input. The sensor uses a thermistor which is sensitive to the change in temperature. The electrical resistance of the thermistor decreases as temperature increases.

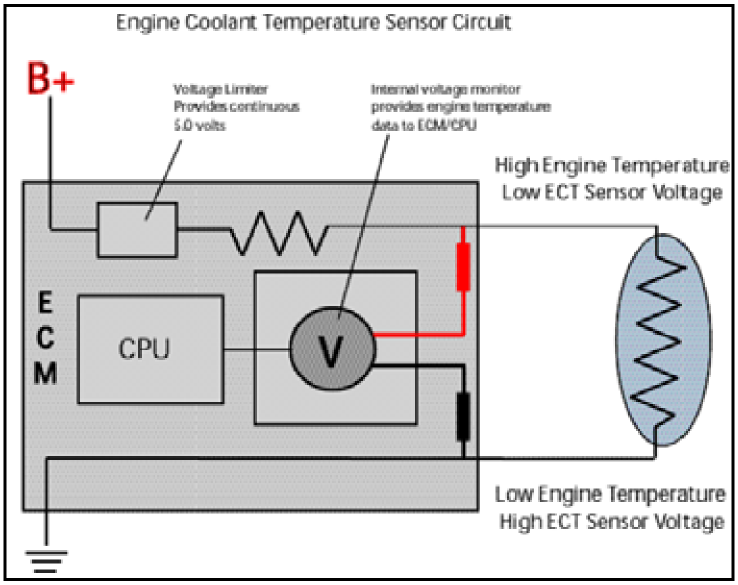


<Reference data>

Engine coolant temperature [°C (°F)]	Voltage* (V)	Resistance (kΩ)
–10 (14)	4.4	7.0 - 11.4
20 (68)	3.5	2.37 - 2.63
50 (122)	2.2	0.68 - 1.00
90 (194)	0.9	0.236 - 0.260



Engine Temperature Coolant sensor circuit operation is detailed in the following graphic.



The ECM supplies the Coolant sensor with a 5 volt Power Supply.

The resistor in the ECM is a fixed value and provides a second 'load' in the circuit.

When coolant is cold, ECT resistance is high and the voltage measured by the ECM remains high.

As the coolant warms up, ECT resistance decreases. Most of the 5 volt power supply then drops across the fixed resistor in the ECM.

The ECT has a variable voltage drop, and the ECM reads this changing voltage to adjust the air fuel mixture.

The following screen print shows 'Fail Safe' conditions for the Engine Coolant Sensor. Several conditions will put the ECM in Fail Safe to insure the engine can operate without damage or increased emissions.

P0117 P0118	Engine coolant temperature sensor circuit	Engine coolant temperature will be determined by ECM based on the time after turning ignition switch ON or START. CONSULT-II displays the engine coolant temperature decided by ECM.	
		Condition	Engine coolant temperature decided (CONSULT-II display)
		Just as ignition switch is turned ON or START	40°C (104°F)
		More than approx. 4 minutes after ignition ON or START	80°C (176°F)
		Except as shown above	40 - 80°C (104 - 176°F) (Depends on the time)
		When the fail-safe system for engine coolant temperature sensor is activated, the cooling fan operates while engine is running.	

If the coolant sensor circuit develops an open or short, the ECM will set one of the Diagnostic Trouble Codes (DTCs) shown in the fail safe chart above. The CONSULT-III will display a temperature of 104°F when the engine is started, and that temperature will gradually increase if the engine is running. 104°F is a temperature low enough to richen the mixture and enable the engine to start under most conditions. After the engine has been running 4 minutes, the CONSULT-III will display 176°F. This is operating temperature and enables the ECM to control emissions systems and insure good driveability. The ECM provides 'Fail Safe' conditions in the event of several component failures. ECT, Mass Air Flow and Throttle sensors are examples of components that may put the ECM in fail safe if they set a DTC.

Normality and Rationality DTCs

OBD II regulations required all manufacturers to program their ECMs to set consistent DTCs for common components. For example: P0117 & P0118 are common to all manufacturers for Engine Coolant sensor circuit failures. P0117 or P0118 are set if the ECM determines that sensor input voltage is too high or too low, usually resulting from an open or short circuit.

Nissan and Infiniti ECCS Systems have monitored major sensors for open or short circuits prior to OBD II regulations. In most circumstances, an unusually high voltage value indicates an open electrical circuit and an unusually low voltage value indicates a shorted electrical circuit.

DTC Logic

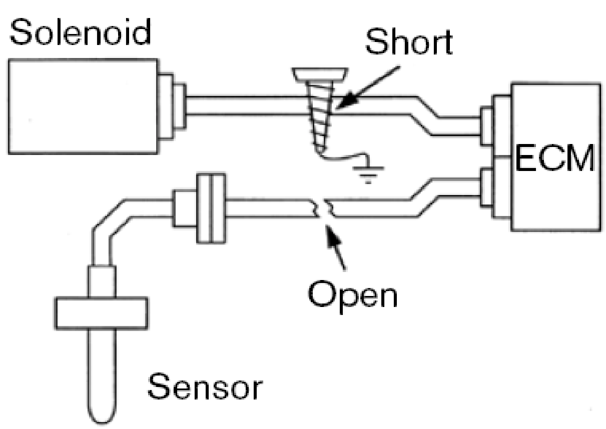
DTC DETECTION LOGIC

DTC No.	Trouble Diagnosis Name	DTC Detecting Condition	Possible Cause
P0117	Engine coolant temperature sensor circuit low input	An excessively low voltage from the sensor is sent to ECM.	• Harness or connectors (The sensor circuit is open or shorted.) • Engine coolant temperature sensor
P0118	Engine coolant temperature sensor circuit high input	An excessively high voltage from the sensor is sent to ECM.	

The chart above describes 'Normality' type detection logic.

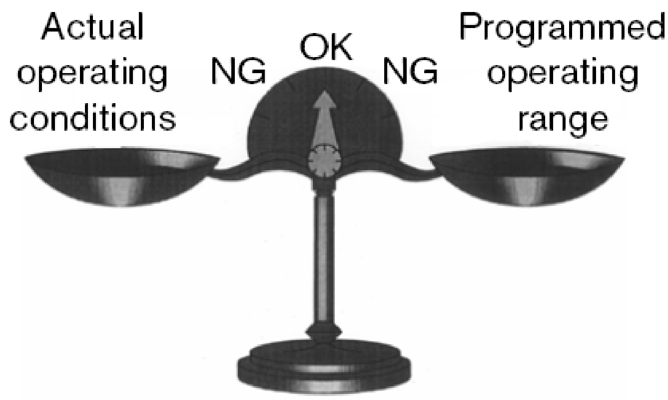
Normality

The system sets a Diagnostic Trouble Code (DTC) when the Engine Control Module (ECM) detects an open or short in monitored circuits. This SELF-DIAGNOSIS system is widely used to monitor the operation of many input sensors and actuators.



Rationality

OBD II regulations require that the Engine Control Module (ECM) monitor the operation of a system or component for deterioration. Rationality DTCs involve complex diagnostic logic and in many cases require the addition of dedicated sensors to monitor the operation of a system.



Rationality detection logic is designed to find problems that result from sensors or systems that are not operating within normal ranges. Usually these failures do not involve open or short circuits and may be more difficult to detect.

DTC DETECTION LOGIC

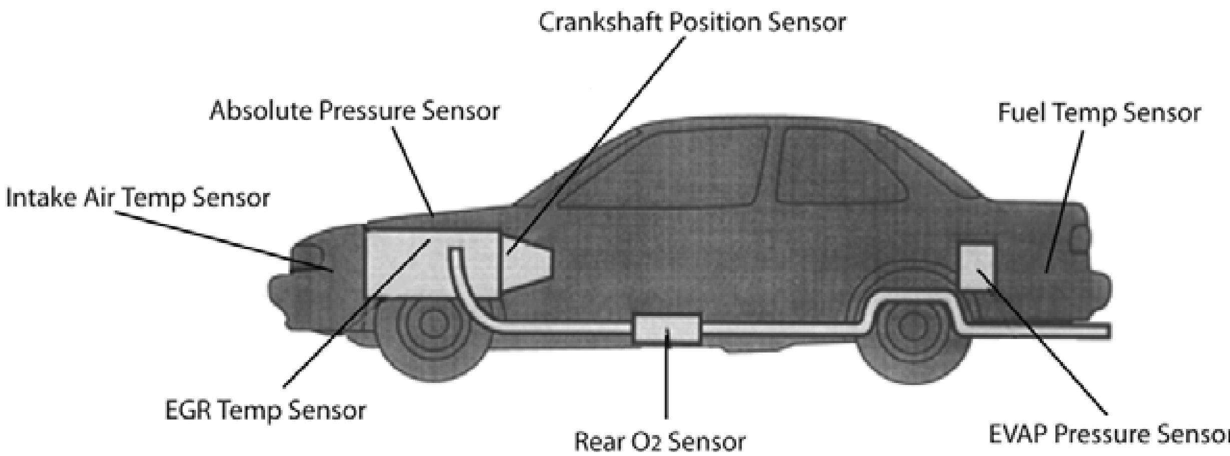
NOTE:

If DTC P0125 is displayed with P0117 or P0118, first perform the trouble diagnosis for DTC P0117 or P0118. Refer to EC-184, "DTC Logic".

DTC No.	Trouble diagnosis name	DTC detecting condition	Possible cause
P0125	Insufficient engine coolant temperature for closed loop fuel control	• Voltage sent to ECM from the sensor is not practical, even when some time has passed after starting the engine. • Engine coolant temperature is insufficient for closed loop fuel control.	• Harness or connectors (High resistance in the circuit) • Engine coolant temperature sensor • Thermostat

The Detection Logic for a coolant sensor with a 'Rationality' type DTC is shown above. If a P0125 DTC is set, the ECM has determined that the ECT sensor voltage is not practical considering how long the engine has been running. Although a harness or sensor problem could cause this DTC, the thermostat is also listed as possible cause. P0125 is rarely set on Nissan or Infiniti vehicles, and would usually only occur if the coolant sensor indicated low temperatures after the engine had been running for about 15 minutes.

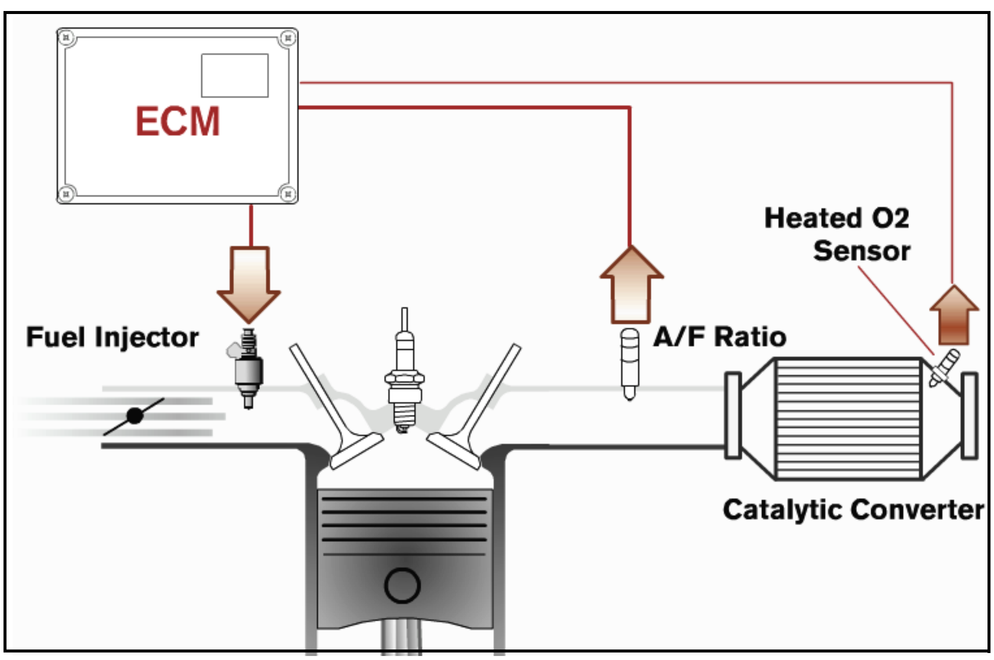
Some sensors are used to help the ECM diagnose 'Rational' type failures. The Intake Air Temperature sensor is used to diagnose P0125. Some other sensors used to diagnose OBD II systems are shown below.



The OBD II Systems Diagnosis and Repair training course covers Rationality diagnostics and OBD II controls in greater detail. The ESM will identify DTC Detection Logic and possible causes for each DTC. Review this information to save time troubleshooting problems that use these sophisticated diagnostics.

Feedback Control

A/F Sensors



Feedback Control describes how A/F sensors (or O2 sensors) control the fuel injector pulse. The input signals from the POS and Phase sensors, the Mass Air Flow sensor and ECT sensor have the greatest affect on the air / fuel mixture. The A/F sensor input signal will cause the ECM to increase or decrease injector pulse based on the mixture in the exhaust manifold.

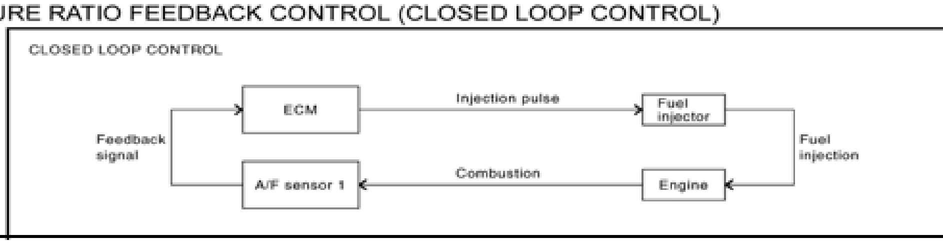
VARIOUS FUEL INJECTION INCREASE/DECREASE COMPENSATION

In addition, the amount of fuel injected is compensated to improve engine performance under various operating conditions as listed below.

<Fuel increase>
- During warm-up
- When starting the engine
- During acceleration
- Hot-engine operation
- When selector lever is changed from N to D (CVT models)
- High-load, high-speed operation

<Fuel decrease>
- During deceleration
- During high engine speed operation

MIXTURE RATIO FEEDBACK CONTROL (CLOSED LOOP CONTROL)



The chart above is typical of Nissan and Infiniti vehicles. When the vehicle is in CLOSED LOOP CONTROL, the A/F sensor input will control the mixture. The chart lists conditions when the vehicle will not be in closed loop. The A/F sensor will not control the mixture in 'Open Loop'.

If the mixture in the exhaust manifold indicates the vehicle is too rich or too lean, the feedback signal from the A/F sensor will correct the mixture.

Air Fuel (A/F) sensors have replaced O2 sensors as the primary component for mixture control on Nissan and Infiniti vehicles. Oxygen (O2) sensors can only determine the amount of oxygen in the exhaust, but the signal from A/F sensors provides more precise mixture feedback for the ECM.

The Heated O2 sensor sends an input signal to the ECM indicating the amount of oxygen in the exhaust after the catalytic converter. This signal is used to diagnose catalyst failures. The rear O2 sensor may be used to affect the air / fuel mixture if the A/F sensor fails.

A/F sensors rely on changes in current flow to provide mixture input to the ECM. CONSULT-III does not display this very small current. Instead, the CONSULT will display about 1.5 volts, or 2.2 volts on vehicles produced after 2007, if the mixture is at the ideal ratio of 14.7 parts air to 1 part fuel. If the mixture becomes rich, CONSULT-III will display a lower voltage. Lean mixtures will display higher voltages.

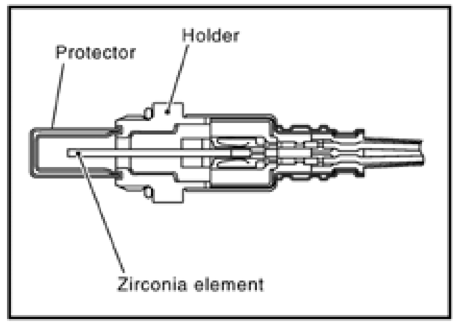
P0130, P0150 A/F SENSOR 1

Description

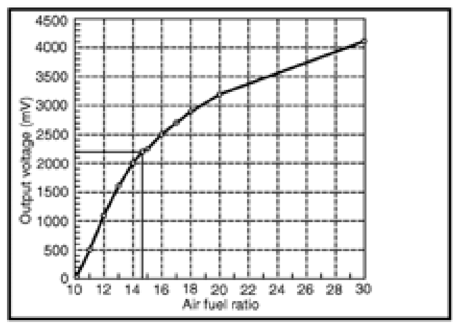
The air fuel ratio (A/F) sensor 1 is a planar one-cell limit current sensor. The sensor element of the A/F sensor 1 is composed an electrode layer, which transports ions. It has a heater in the element.

The sensor is capable of precise measurement λ = 1, but also in the lean and rich range. Together with its control electronics, the sensor outputs a clear, continuous signal throughout a wide λ range.

The exhaust gas components diffuse through the diffusion layer at the sensor cell. An electrode layer is applied voltage, and this current relative oxygen density in lean. Also this current relative hydrocarbon density in rich.



Therefore, the A/F sensor 1 is able to indicate air fuel ratio by this electrode layer of current. In addition, a heater is integrated in the sensor to ensure the required operating temperature of about 800°C (1,472°F).



DTC Logic

DTC DETECTION LOGIC

To judge the malfunction, the diagnosis checks that the A/F signal computed by ECM from the A/F sensor 1 signal fluctuates according to fuel feedback control.

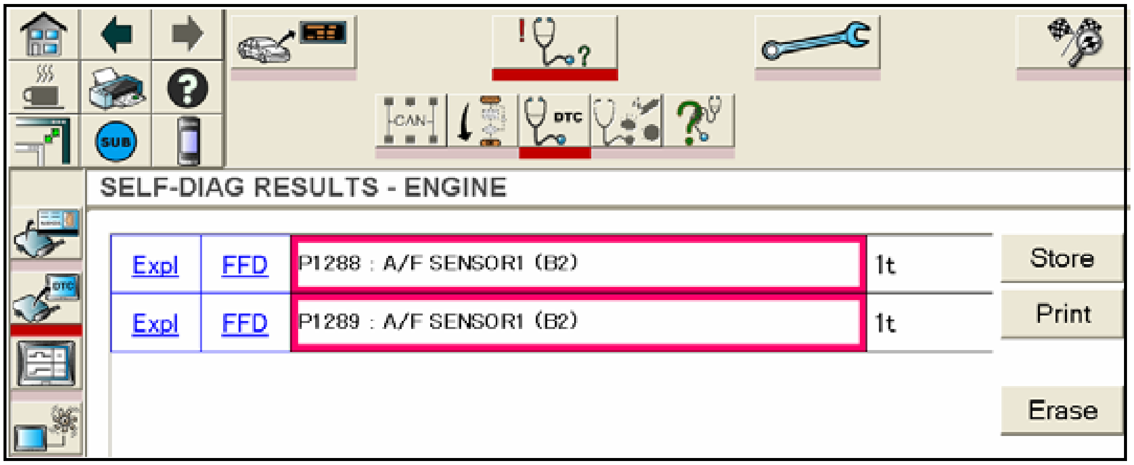
The ESM information above describes the construction of A/F sensors. Air / Fuel sensors operate over a wide band of voltage, but Oxygen or O2 sensors operate over a narrow band.

If the mixture varies from 14.7 parts air to 1 part fuel, the O2 sensor signals the ECM to indicate the mixture is either rich or lean.

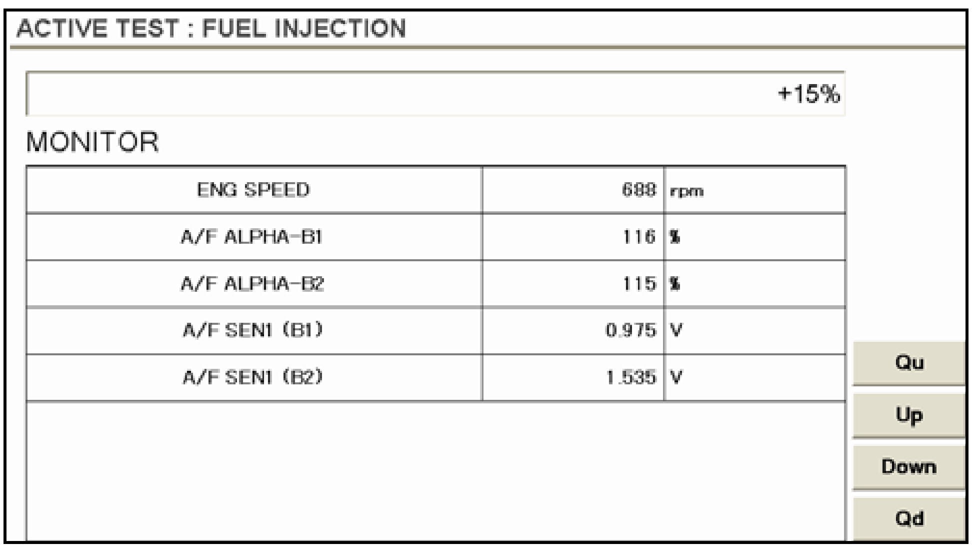
Wide band Air / Fuel sensors indicate how rich or how lean the mixture has become, and the ECM can use this feedback for more precise mixture control.

Nissan and Infiniti vehicles began using wide band A/F sensors in 2004 for most models and all mixture ratio feedback systems currently rely on these sensors.

A/F Sensor Troubleshooting



A/F Sensors will set a variety of DTCs if the ECM detects a problem with the sensor circuit. High or low voltage, or a sensor that is slow to respond to changes in the mixture will set a code. The ESM will recommend CONSULT-III Active test be used to test the sensor. The Active Test enables the technician to richen or lean the mixture and confirm the A/F sensor is responding.



In this example, the Active Test increased the injector pulse by 15%.

A/F SEN 1 (B1) responded to the rich mixture with a lower voltage.

A/F SEN 1 (B2) did not respond, remaining at 1.5 volts.

A/F Alpha

CONSULT-III Data Monitor can display the A/F Alpha reading indicating how the Feedback Control system has changed the mixture to correct a lean or rich condition. In the screen print above, the reading reflects that the Active Test has increased the fuel pulse about 15%.

Alpha data is also a useful to determine if the ECM must make a significant change in the injector pulse to correct a problem with the engine control system.

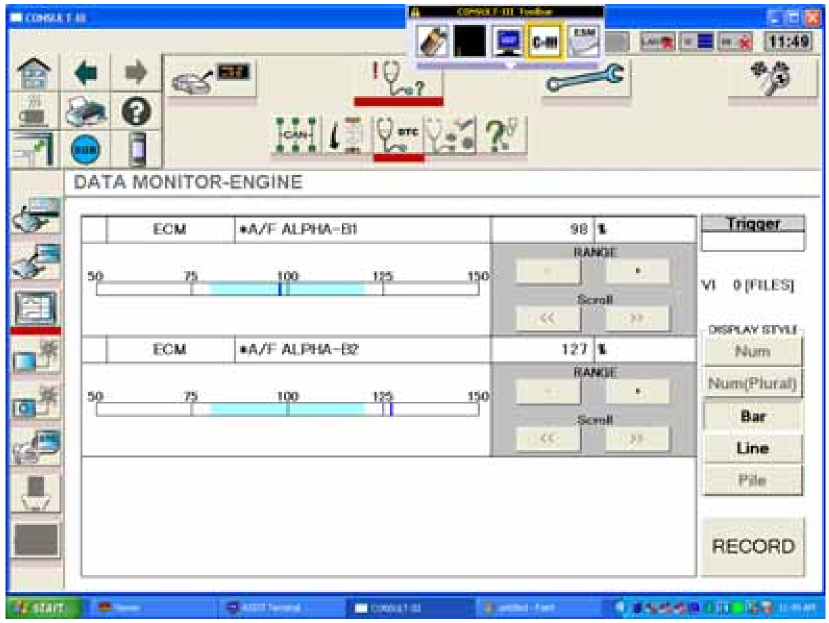
A/F Alpha readings between 91% and 109% are considered to be within the normal range.

This Data Monitor 'SPEC' screen provides a range of acceptable readings for A/F Alpha.

Bank 1 is just under 100% and is within specification.

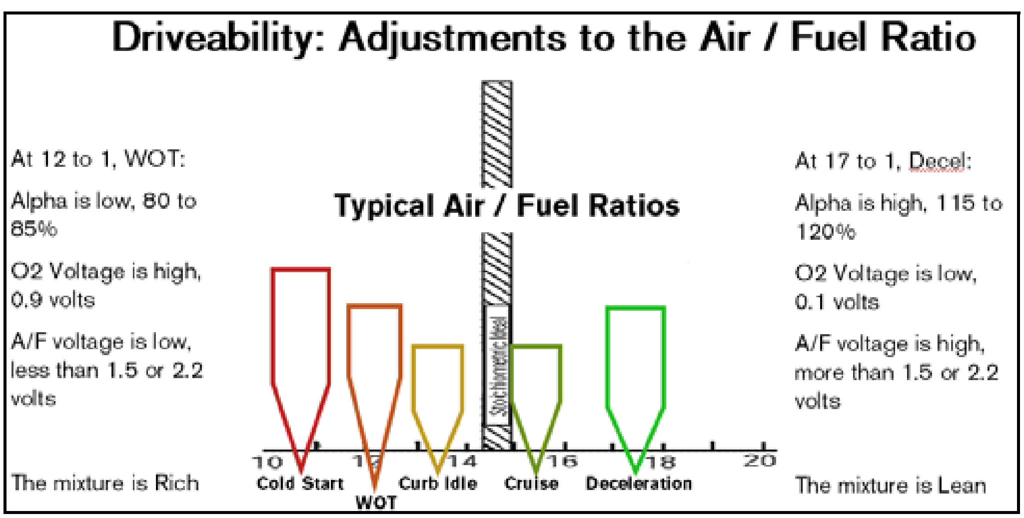
Bank 2 is over 125%. This indicates a very lean mixture on Bank 2 that exceeds allowable limits.

A/F Alpha is how much compensation is required to correct the air / fuel mixture.



If the mixture is maintained close the stoichiometric ideal of 14.7 parts air to 1 part fuel, the A/F Sensor and catalytic converter will be able to efficiently control emissions.

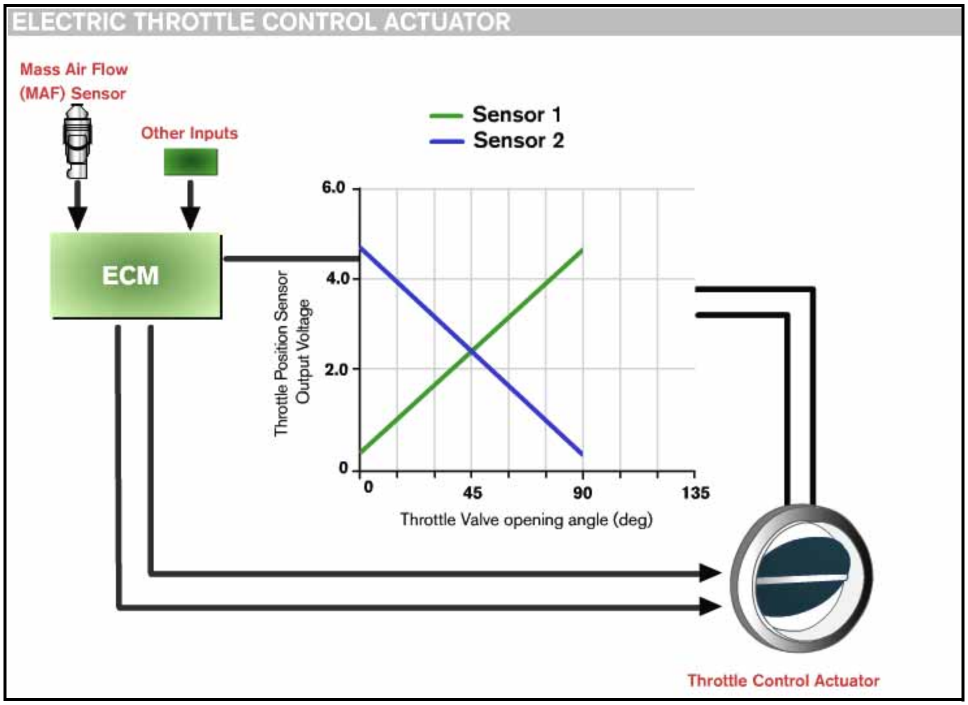
When the engine is operated under different conditions, such as wide open throttle or cruising, the mixture will vary to insure good driveability and protect the engine. Under these conditions, A/F Alpha readings will vary from 100% to reflect the changes in the mixture. Readings between 91% and 109% are considered normal.



When the engine is held at a steady RPM under light loads, the air / fuel mixture should be close to 14.7 to 1, and Alpha will normally indicate about 100%.

Throttle Control System

Electronic Throttle Controls

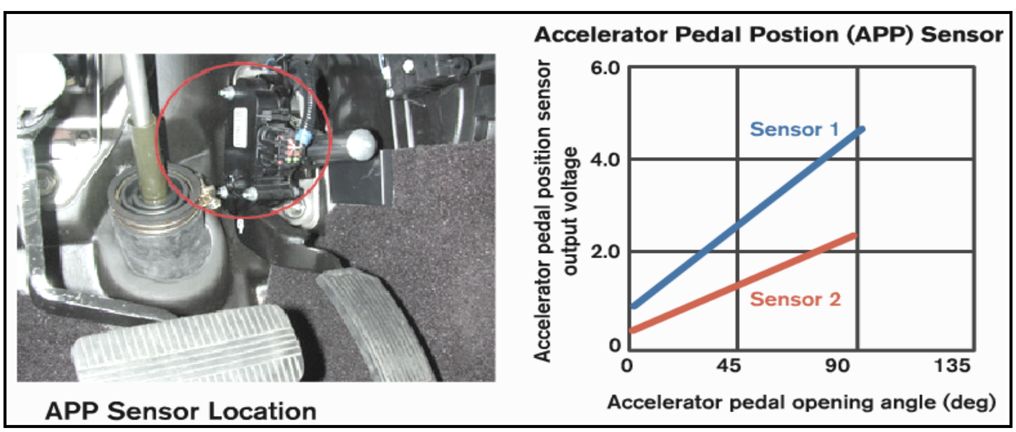


The Throttle Control System for Nissan and Infiniti vehicles consists of two primary components, a throttle control actuator and accelerator pedal position sensor. The ECM will operate the throttle motor in this 'drive by wire' system based primarily on the input signal from the accelerator pedal position (APP) sensor.

The throttle actuator consists of two sensors that provide input voltages to the ECM regarding the opening angle of the throttle valve.

Accelerator Pedal Position Sensor

The Accelerator Pedal Position (APP) sensor is part of the accelerator pedal assembly and sends a variable voltage input signal to the ECM.



Troubleshooting the Throttle Control System

The throttle motor, throttle sensors and APP sensors will each set a specific DTC if the ECM senses a circuit or component failure.

SELF-DIAG RESULTS - ENGINE

Expl	FFD	P2122 : APP SEN 1/CIRC	0	Store
Expl	FFD	P2127 : APP SEN 2/CIRC	0	Print
Expl	FFD	P2138 : APP SENSOR	0	Erase

DTC results above for the APP sensor and results below for the Electronic Throttle

SELF-DIAG RESULTS - ENGINE

Expl	FFD	P1122 : ETC FUNCTION/CIRC	0	Store
Expl	FFD	P0223 : TP SEN 1/CIRC	0	Print
Expl	FFD	P0123 : TP SEN 2/CIRC	0	Erase
Expl	FFD	P2135 : TP SENSOR	0	

CONSULT-III Data Monitor can be used to confirm operation of the throttle position sensors and APP sensors. If these sensors fail, the Throttle Control System will be set into a Fail Safe condition by the ECM. This will limit throttle valve openings. The chart below describes the typical Fail Safe conditions for a number of possible Throttle Control System failures.

< ECU DIAGNOSIS > [VQ35DE]

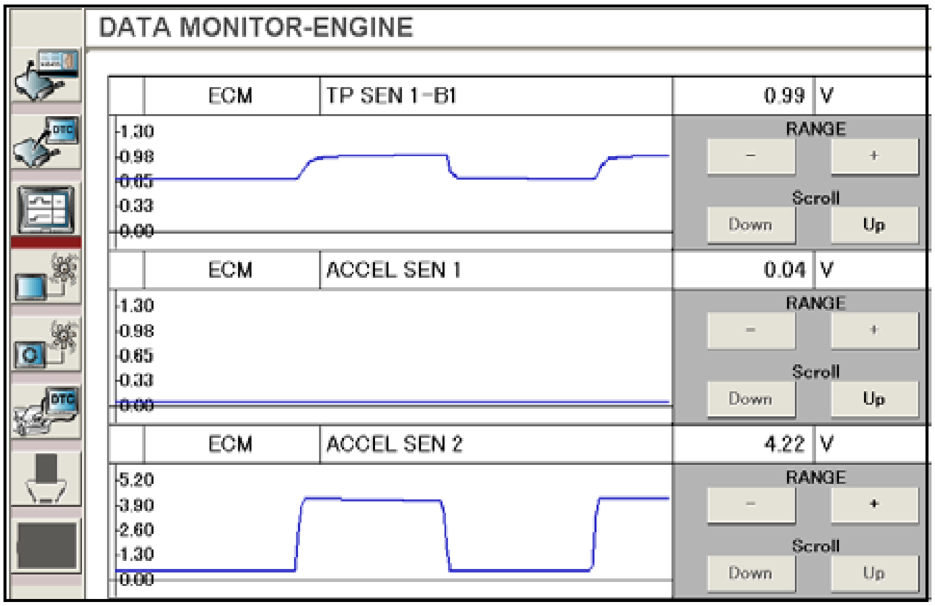
DTC No.	Detected items	Engine operating condition in fail-safe mode
P2119	Electric throttle control actuator	(When electric throttle control actuator does not function properly due to the return spring malfunction:) ECM controls the electric throttle actuator by regulating the throttle opening around the idle position. The engine speed will not rise more than 2,000 rpm.
		(When throttle valve opening angle in fail-safe mode is not in specified range:) ECM controls the electric throttle control actuator by regulating the throttle opening to 20 degrees or less.
		(When ECM detects the throttle valve is stuck open:) While the vehicle is driving, it slows down gradually by fuel cut. After the vehicle stops, the engine stalls. The engine can restart in N or P (CVT), Neutral (M/T) position, and engine speed will not exceed 1,000 rpm or more.
P2122 P2123 P2127 P2128 P2138	Accelerator pedal position sensor	The ECM controls the electric throttle control actuator in regulating the throttle opening in order for the idle position to be within +10 degrees. The ECM regulates the opening speed of the throttle valve to be slower than the normal condition. So, the acceleration will be poor.

Throttle Control System Data Monitor

In this screen print, ACCEL SEN 2 displays 4.22 volts indicating the pedal sensor signal is ‘requesting’ Wide Open Throttle.

ACCEL SEN 1 displays 0.01 volts, indicating a circuit or component failure.

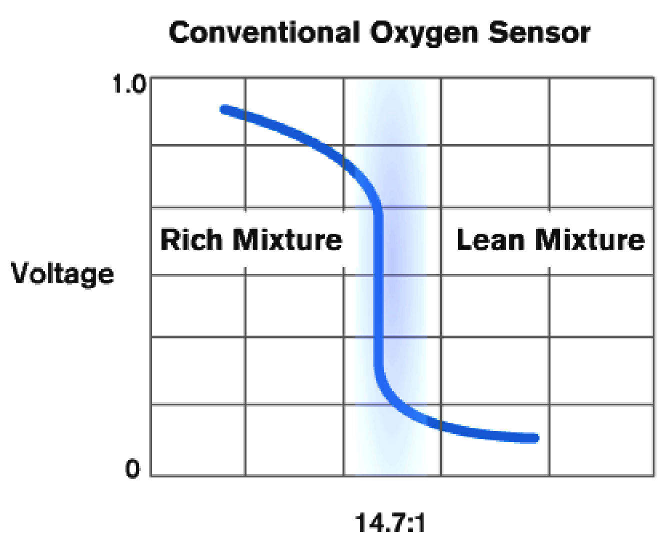
In this Fail Safe condition, the throttle blade has only opened a small amount.



Oxygen (O2) Sensors

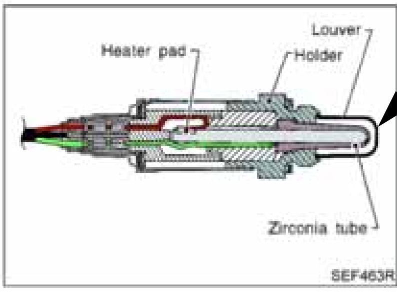
Heated O2 Sensor

Since the HO2S does not provide a reliable signal until it reaches approximately 662 to 752 degrees F (350 – 400 degrees C), an integrated heater is used to rapidly raise the temperature of the sensor

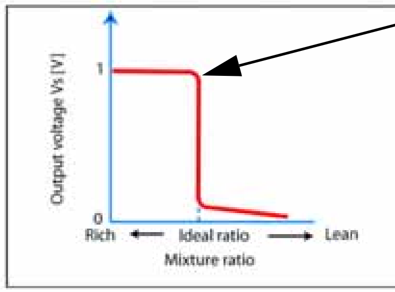


Nissan and Infiniti vehicle used Front O2 sensors to input air / fuel mixture feedback signals on models produced through the 2004 or 2005 model year. Vehicles produced since that time use A/F sensors to provide more precise feedback to the ECM, in order to better control the air / fuel mixture.

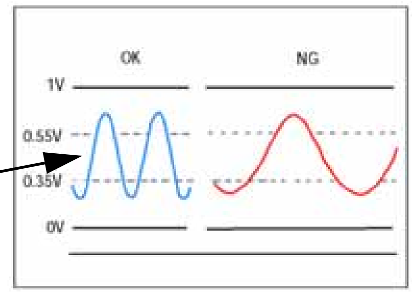
Front O2 Sensors



The Zirconia element in the O2 sensor generates voltage based on the exhaust oxygen levels



Voltage near 1 volt indicates a rich mixture.
Voltage near 0.0 volts indicates the mixture is lean.



Front O2 sensors vary mixture control by cycling from high to low voltage as the ECM changes the mixture from slightly rich to slightly lean. A 'lazy' sensor that cycles too slowly will set a DTC.

Front Oxygen sensors are considered to be operating properly if they cycle from 0.0 volts to 0.3 volts, indicating they can accurately measure high oxygen content and a lean mixture in the exhaust.

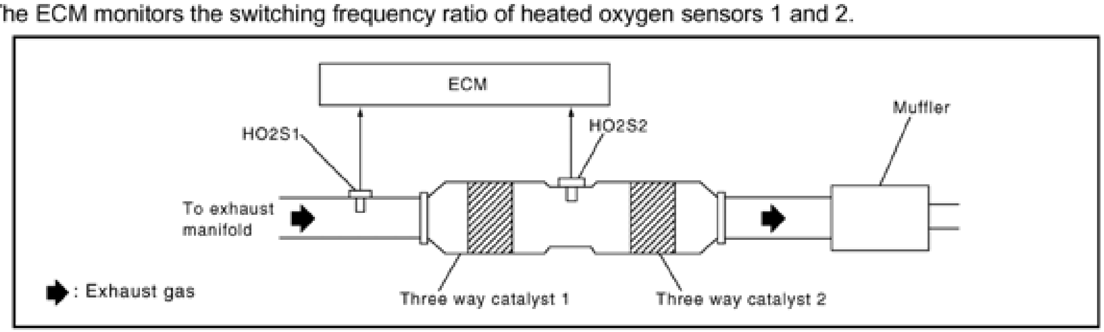
They must also cycle from 0.6 to about 1.0 volts to indicate they can identify low oxygen content and a rich mixture. Most Nissan and Infiniti ESMs indicate they should cycle between high and low voltage at least 5 times in 10 seconds. 1 cycle per second is typical of a O2 sensor measured at a steady 2000 RPM after the engine and O2 sensor reach operating temperature.

Rear O2 Sensors

Rear O2 sensors are essentially the same as front sensors. All Nissan and Infiniti vehicles currently rely on these sensors to determine the condition of the catalytic converter.

On Board Diagnosis Logic

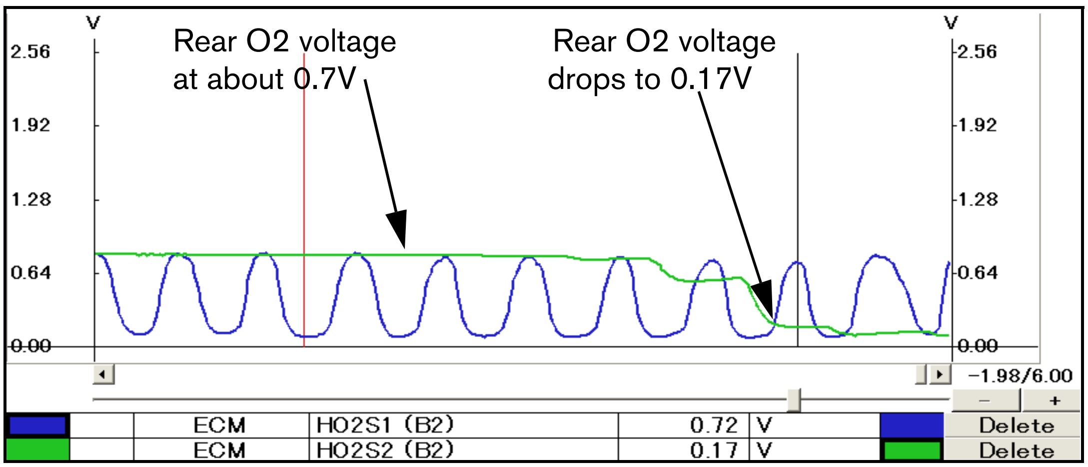
The ECM monitors the switching frequency ratio of heated oxygen sensors 1 and 2.



O2 Sensor Troubleshooting

OBD II regulations require manufacturers to monitor the condition of the catalytic converter. The rear O2 sensor provides the ECM input that is used to judge the performance of the catalyst.

Unlike in the exhaust system before the catalyst, the amount of oxygen measured after the catalyst should not change frequently. The catalyst should absorb and store oxygen to enable the reactions in the catalyst that reduce HC and CO emissions. The CONSULT-III Data Monitor graphic shows a front and rear O2 sensor both working properly, and a catalyst that has adequate oxygen storage capacity.



The Front O2 sensor cycles about 10 times in 8 seconds and meets the high and low voltage requirements. The Rear O2 sensor also meets the requirements to read both high and low oxygen content, but it is cycling slowly indicating that the catalyst is working properly.

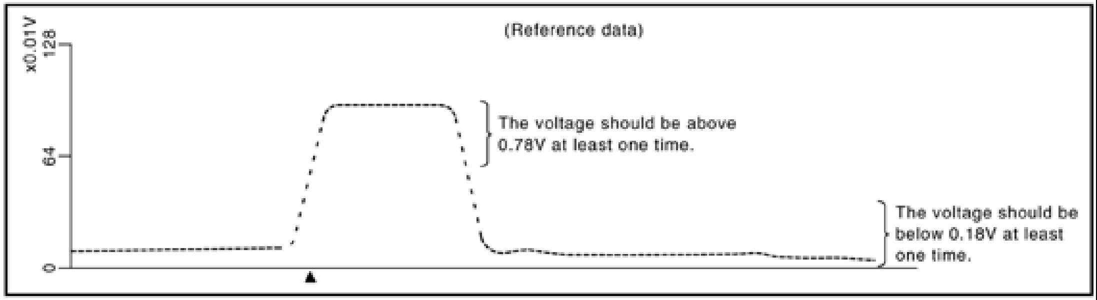
Nissan and Infiniti ESMs recommend using the CONSULT-III Active Testing as an easy way to confirm that the Front or Rear O2 sensors are reacting to changes in the mixture. The Fuel Injection Active Test enables technicians to dramatically richen or lean the mixture. The O2 sensor voltage for both front and rear sensors should respond with a high voltage (about 1.0 volts) when the mixture is 25% rich. When the Active Test is used to lean the mixture, O2 sensor voltage should be low (about 0.0 volts).

Front O2 sensors are equipped with heaters that the ECM turns On as soon as the vehicle is started. These heaters are required because the sensor must be hot to provide accurate feedback and control the mixture quickly.

O2 sensors will not respond quickly unless they reach operating temperatures of about 700 °F. CONSULT-III can be used to monitor the sensor heaters and confirm that they have turned On.

Rear O2 sensors are not heated until the engine has been run over about 3500 RPM or driven for several minutes. The ESM will provide details regarding the operating conditions for the front or rear O2 heaters. Rear O2 heaters should be confirmed On using CONSULT-III before they are tested.

Check "HO2S2 (B1)/(B2)" at idle speed when adjusting "FUEL INJECTION" to ±25%.



"HO2S2 (B1)/(B2)" should be above 0.78V at least once when the "FUEL INJECTION" is +25%.
"HO2S2 (B1)/(B2)" should be below 0.18V at least once when the "FUEL INJECTION" is –25%.

The catalytic converter cannot absorb enough oxygen to 'clean up' the mixture if it has been enriched 25% using the CONSULT-III Fuel Injection Active Test. In the screen print from the ESM, the CONSULT graph indicates that the rear O2 sensor is responding properly.

A/F Alpha

LOW A/F Alpha
Injector Pulse **Shortened**

Very Rich 80% | **Rich** 90%

NORMAL RANGE
91% 100% 109%

HIGH A/F Alpha
Injector Pulse **Lengthened**

Lean 110% | **Very Lean** 120%

Longer at 0.9V ← O_2 Voltage Fluctuates → Longer at 0.1V

Lower A/F Alpha %
[ECM reduces pulse width]
Lower A/F Alpha (less than 91%) indicates that the mixture is too rich. This causes the ECM to shorten its calculated fuel injector pulse duration in order to lean out the A/F mixture. For example, an A/F Alpha reading of 85% is indicative of a rich running condition.

100% A/F Alpha
[No correction]
Normal A/F Alpha readings range between 91–109%. This allows the ECM's calculated fuel injector pulse duration to be within +/-10% of the ideal A/F mixture.

•When A/F Alpha locks on 100%, the vehicle is most likely in fail-safe mode.

Higher A/F Alpha %
[ECM increases pulse width]
Higher A/F Alpha (greater than 109%) indicates that the mixture is too lean. This causes the ECM to lengthen its calculated fuel injector pulse duration in order to enrich the A/F mixture. For example, an A/F Alpha reading of 115% is indicative of a lean running condition.

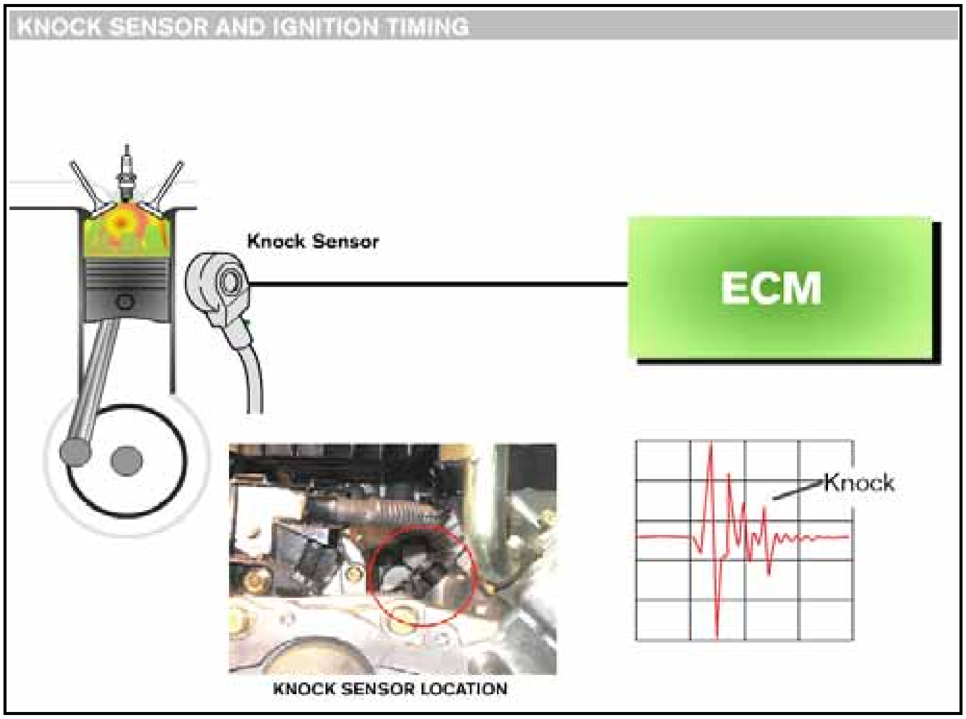
A/F Alpha readings are dependent on the mixture and mixture feedback control systems. This chart provides information regarding how the O2 sensors and ECM work together to control the mixture so that Alpha remains between 91% and 109%.

Input Information

There are inputs to the ECM that contribute to the length of the fuel injector pulse or the ignition timing, but have less influence than the sensors already reviewed in this text. Examples of these signals are inputs from the Transmission Control Module (TCM) and ABS Control Unit.

Knock Sensor

Knock sensors will control ignition timing advance if the engine begins to detonate.



The knock sensor generates a signal like the one shown here.

This signal results if the engine develops pre-ignition or 'engine knock'.

The ECM retards the ignition timing until the knock signal indicates that there is no longer pre-ignition.

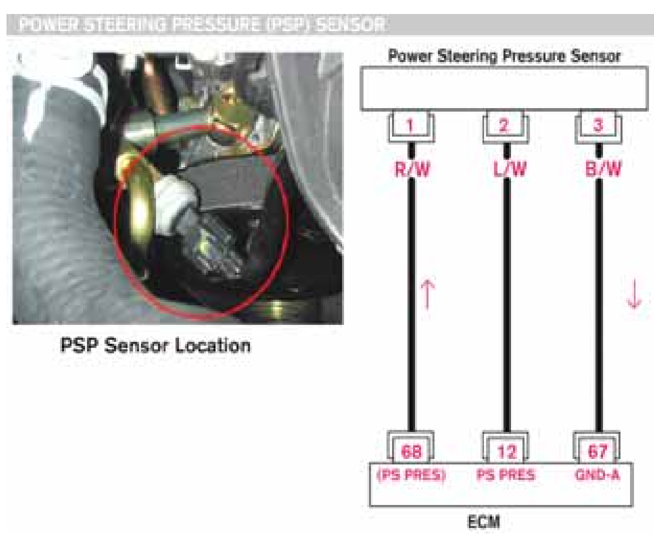
Low fuel octane is the usual cause of engine knock.

Power Steering Pressure Switch

The Power Steering Pressure Switch (PSP) provides input to the ECM regarding power steering pump assist.

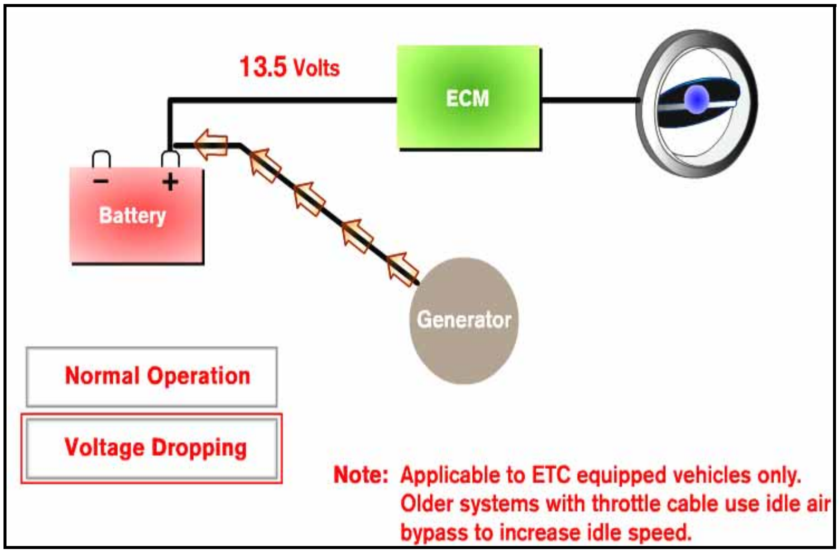
If the power steering system is putting a load on the engine at low RPM, the ECM will open the throttle to increase idle speed.

The ECM will detect a DTC if the Power Steering signal voltage is too high or too low.



Battery Voltage

A drop in battery voltage will require the alternator to increase the current used to recharge the battery.



If battery voltage drops below a specific voltage, the alternator will increase current required to recharge the battery.

This increased load on the engine might result in a lower RPM.

The ECM will open the throttle if necessary to increase engine speed.

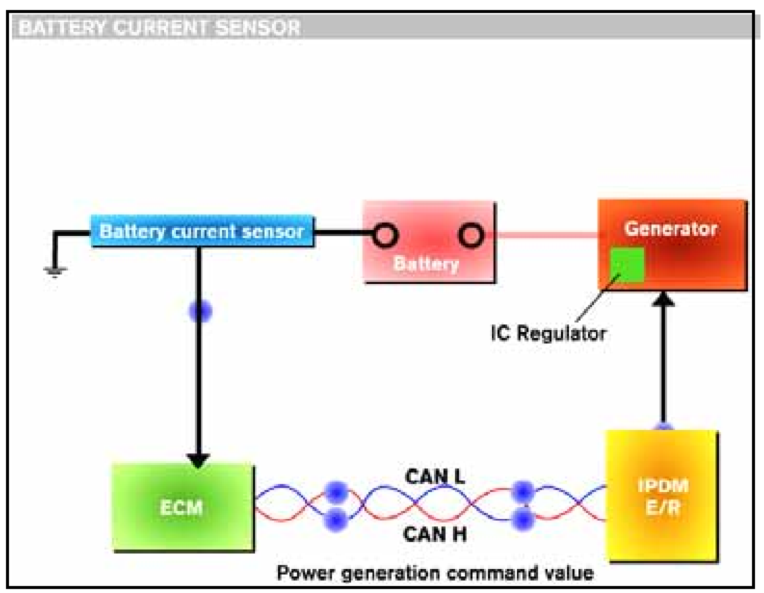
Battery voltage is also used on most Nissan and Infiniti vehicles to adjust both fuel injector pulse duration and ignition timing when the vehicle is started. The ECM will monitor battery voltage and engine speed. If these input signals confirm the vehicle is being started, the injector pulse duration will be increased.

Many Nissan and Infiniti models feature a Battery Current sensor.

In contrast to the ECM increasing idle speed when the battery is being charged, this system reduces generator output.

When battery voltage is adequate and electrical loads are low, the ECM will reduce battery charging current to minimize engine loads.

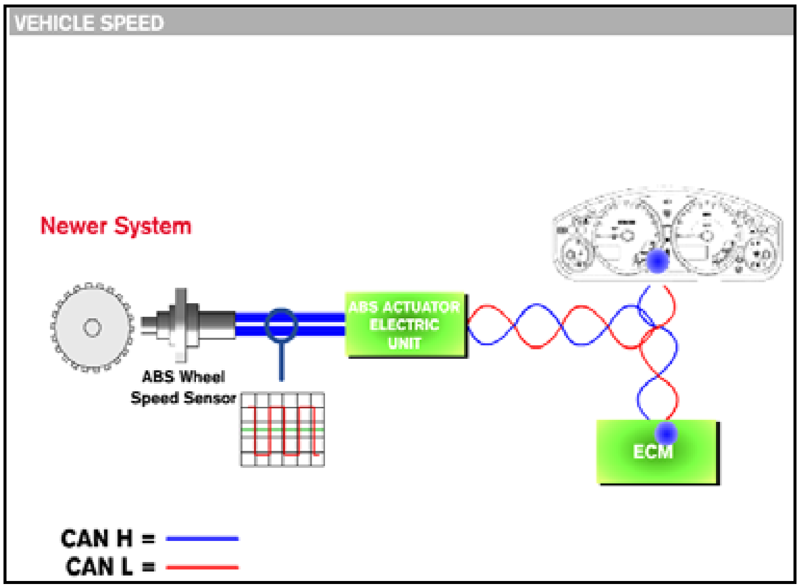
The CAN system will send the command from the ECM to the IPDM-ER to reduce charging current.



ABS and VDC Inputs

The Antilock Braking and Vehicle Dynamic Control systems each effect ECCS engine controls. The ABS system inputs vehicle speed data to the ECM. If the vehicle has a Traction Control (TCS) or Vehicle Dynamic Control (VDC) system, this input signal can be used to enhance vehicle control. If the ABS control unit senses that wheel speed indicates drive wheels are losing traction, the ECM will control the Electronic Throttle to reduce engine power.

Vehicles with VDC systems sense yaw and G force rates. If these inputs indicate understeer or oversteer, the ECM will control engine power so the driver can maintain control of the vehicle.



The Controller Area Network (CAN) system connects the ABS / VDC control unit to the ECM.

The ABS control unit provides the ECM with vehicle speed input data.

On vehicles equipped with Traction Control or VDC, data from the control unit to the ECM will improve driver control of the vehicle by limiting engine power until all four wheel speed signals are consistent.

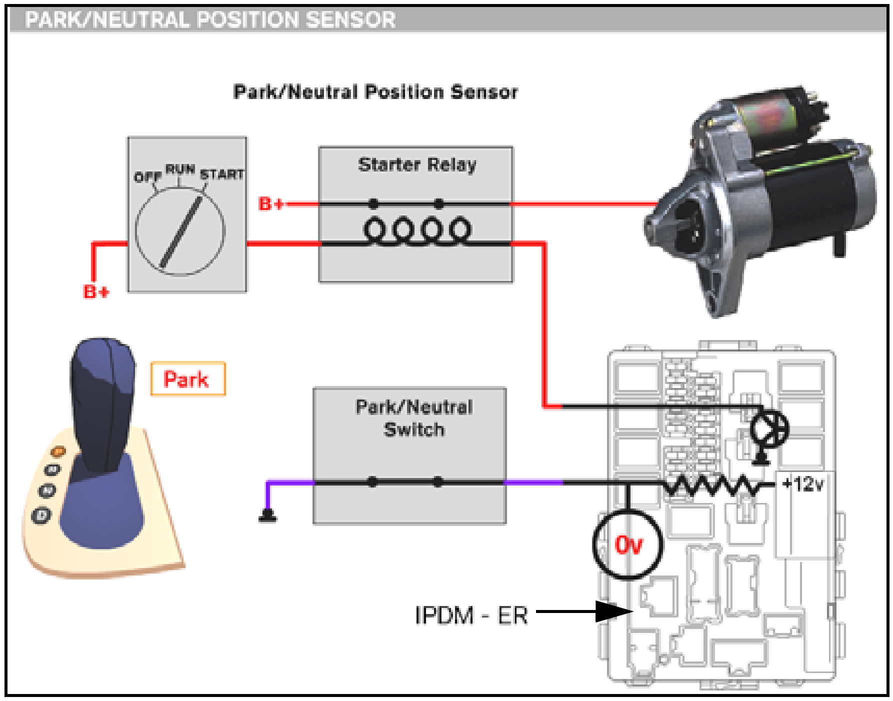
Park Neutral Position (PNP) Switch Input

The PNP switch provides an input signal that indicates the automatic transmission range selected by the driver. This input controls engine starting and affects many actuators including fuel injection, ignition timing and electronic throttle position.

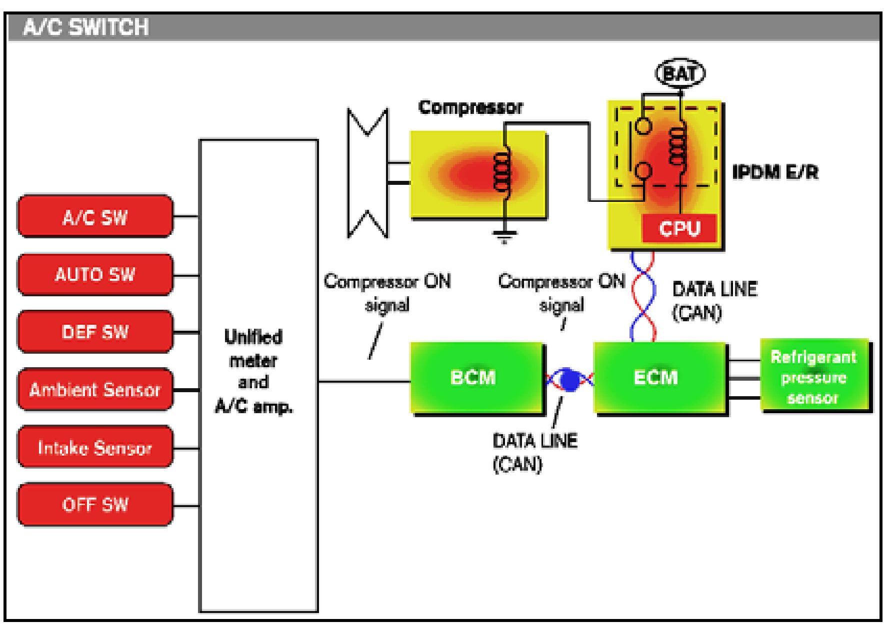
Nissan and Infiniti vehicles use the Intelligent Power Distribution Module (IPDM-ER) in the Engine Room to control engine starting on many models.

The PNP Switch is the critical input to control the starter relay for these systems.

The PNP switch is an input for the Body Control Module (BCM) and the ECM on most Nissan and Infiniti models



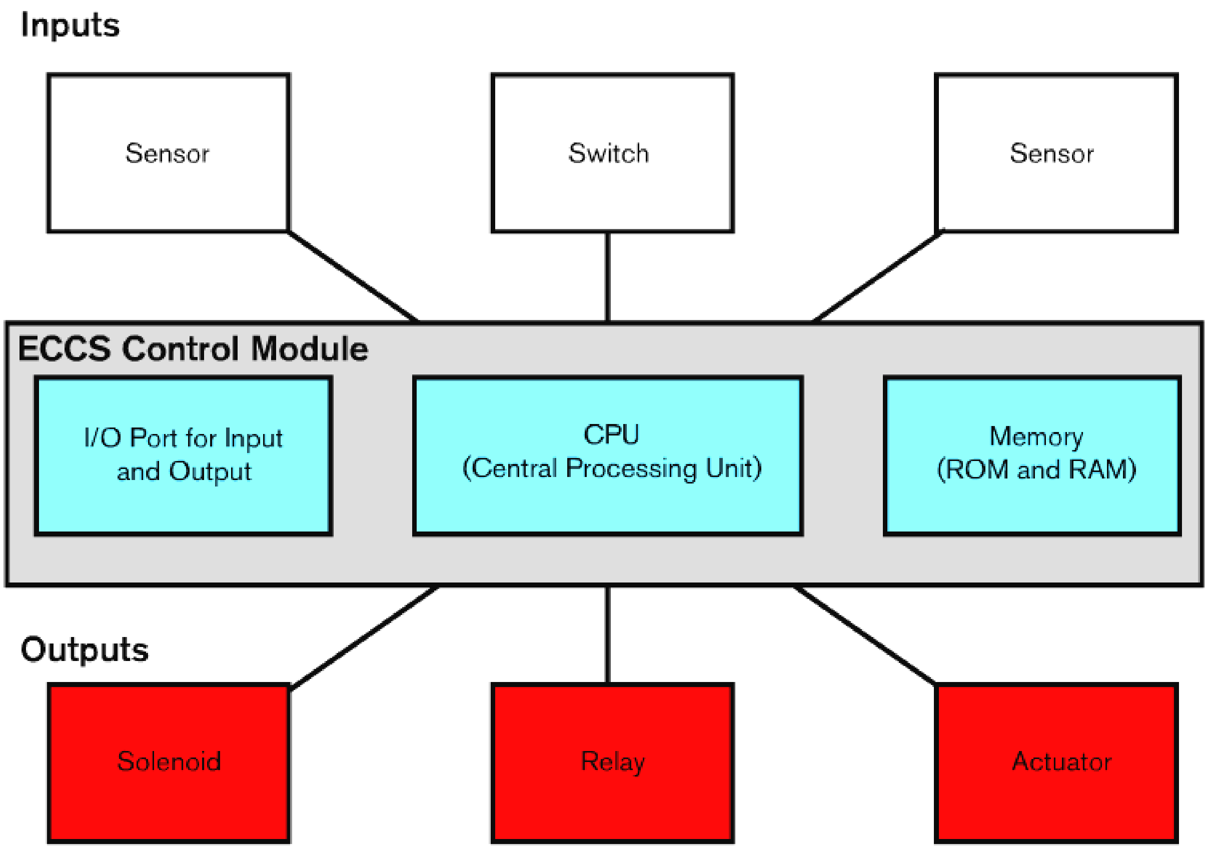
AC Input Signal and Body Control Module (BCM)



Nissan and Infiniti vehicles use the Body Control Module (BCM) to control many functions including engine starting, power locks and windows and lighting circuits.

The AC compressor is cycled On or Off by the ECM based on input information from the BCM and Unified Meter assembly.

Engine Control Module



The Engine Control Module or ECM is the 'brains' of the Electronic Concentrated Engine Control (ECCS) System.

The ECM gathers all the input information from sensors, processes the data and operates the actuators that control the engine. Fuel injector pulse duration, throttle opening, ignition timing and evaporative controls are just some of the actuators controlled by the ECM.

The ECM also contains short term and long term 'memory' to fine tune the air / fuel mixture. Alpha and Self Learning control are adjustments made by the ECM to correct the mixture based on feedback data from the A/F or oxygen sensors.

The Engine Control Module also performs Self Diagnosis. The ECM evaluates input signals for 'normality' failures such as high or low voltage, but also judges 'rationality' failures when sensors or actuators operate outside practical ranges. The ECM also stores Diagnostic Trouble Codes and operates the Service Engine Soon (SES) lamp as per OBD II regulations.

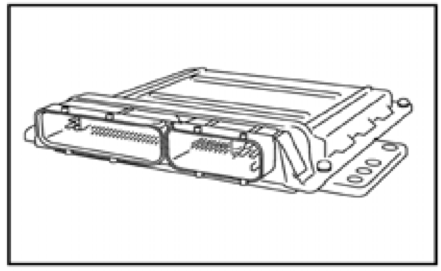
Fail Safe programs are also managed by the ECM in the event specific failures might result in engine damage or emissions problems.

ECM Troubleshooting

DTC P0605 ECM

Component Description

The ECM consists of a microcomputer and connectors for signal input and output and for power supply. The ECM controls the engine.



On Board Diagnosis Logic

This self-diagnosis has one or two trip detection logic.

DTC No.	Trouble diagnosis name	DTC detecting condition		Possible cause
P0605 0605	Engine control module	A)	ECM calculation function is malfunctioning.	• ECM
		B)	ECM EEP-ROM system is malfunctioning.	
		C)	ECM self shut-off function is malfunctioning.	

FAIL-SAFE MODE
ECM enters fail-safe mode when the malfunction A is detected.

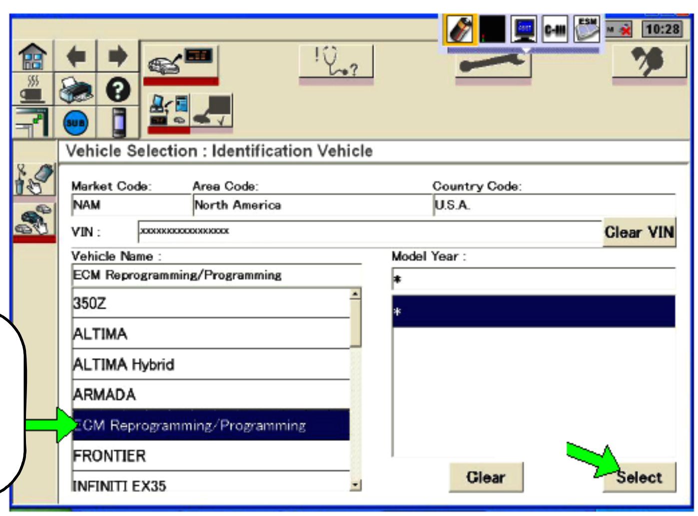
Detected items	Engine operation condition in fail-safe mode
Malfunction A	• ECM stops the electric throttle control actuator control, throttle valve is maintained at a fixed opening (approx. 5 degrees) by the return spring. • ECM deactivates ASCD operation.

In the example shown, P0605 is the DTC that may set in the event of certain ECM failures. This DTC is rarely set on Nissan or Infiniti vehicles.

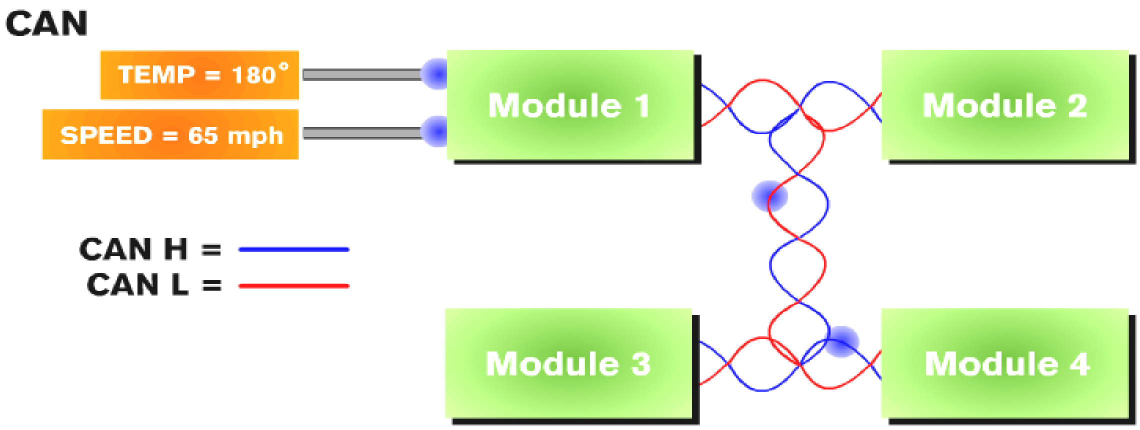
If the vehicle sets a P0605 code, the ECM may go into Fail Safe, and in this example, the fail safe condition would limit the electronic throttle to a very small opening.

Nissan and Infiniti ECMs may be reprogrammed and in many cases, a Technical Service Bulletin (TSB) will detail reprogramming details for some specific DTCs.

CONSULT-III offers ECM Reprogramming to correct some DTCs or performance problems.



CAN Communication



The CAN system links control units, enabling them to share information and simplify the vehicle's electrical wiring.

CONSULT-III provides sophisticated CAN diagnosis capabilities that enable technicians to identify components or connections in the Controller Area Network that are faulty.

CAN Communication System Troubleshooting

U1010 CONTROL UNIT (CAN)

Description

CAN (Controller Area Network) is a serial communication line for real time application. It is an on-vehicle multiplex communication line with high data communication speed and excellent error detection ability. Many electronic control units are equipped onto a vehicle, and each control unit shares information and links with other control units during operation (not independent). In CAN communication, control units are connected with 2 communication lines (CAN H line, CAN L line) allowing a high rate of information transmission with less wiring. Each control unit transmits/receives data but selectively reads required data only.

DTC Logic

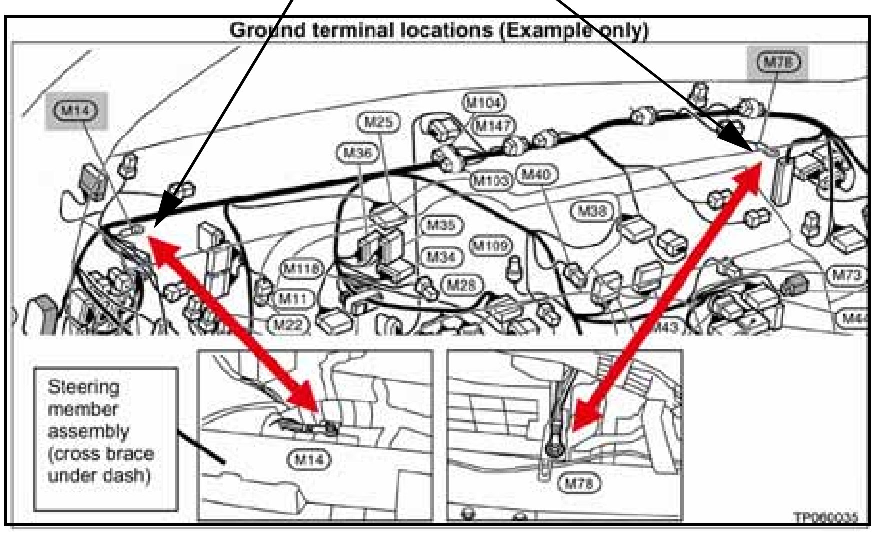
DTC DETECTION LOGIC

DTC No.	Trouble diagnosis name	DTC detecting condition	Possible cause
U1010	CAN communication bus	When detecting error during the initial diagnosis of CAN controller of ECM.	• ECM

Nissan Service Bulletin NTB06 - 009a and Infiniti bulletin ITB06 - 004a provide a repair procedure for vehicles that set a CAN DTC of U1000 or U1010.

DTC RESULTS:	U1000 or U1010
FUEL SYS (xx):	Mode 5
CAL/LD VALUE:	0%
COOLANT TEMP	-40°F or -40°C
L-FUEL TRIM (xx)	100%
S-FUEL TRIM (xx)	100%
ENGINE SPEED	0 rpm
VEHICL SPEED	0 mph or 0 kph
ABSOL TH-P/S	0 % (if applicable)
B/FUEL SCHDL	0 msec
INT/A TEMP SE	-58°F or -50°C

If CONSULT-III indicates a U1000 or U1010 DTC, and if Freeze Frame Data indicates these results, the TBS indicates tightening ground connections (shown below) is the recommended repair.



CAN system DTCs have been caused by poor ground or poor battery connections. Be sure to check ASIST for bulletins if you are working on a vehicle with CAN system DTCs.

Emissions Systems Overview

The OBD II Systems Diagnosis & Repair course focuses on detailed troubleshooting and testing for Nissan and Infiniti emission controls. In this section of the text, we introduce some of the emission control systems that are part of ECCS controls.

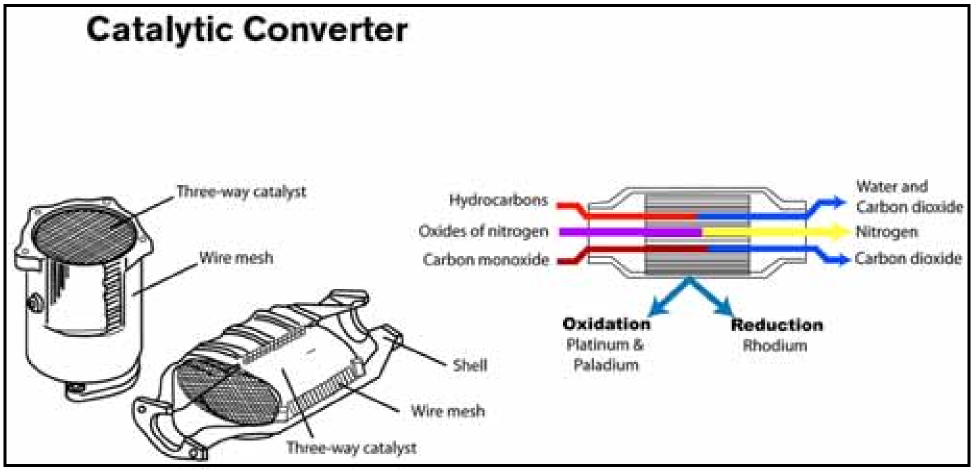
OBD II Regulations

The Clean Air Act of 1990 required manufacturers to engineer On-Board diagnostic controls that would turn on the Service Engine Soon (SES) lamp in the event of emission system failures even if vehicle driveability was not affected. Basic OBD II regulations are listed in the chart.

Diagnostic Item	Summary of Regulations
THREE-WAY CATALYST	Federal Test Procedure (FTP) diagnostic requirement. Diagnoses the deterioration of the three-way catalyst function, resulting in HC emissions exceeding 1.5 times federal emission standards.
ENGINE MISFIRE	Monitors for: ▪ Emissions exceeding 1.5 times federal emission caused by engine misfire ▪ Damaged catalyst due to engine misfires. FTP provides continuous monitoring of engine load and engine speed ranges relative to normal torque conditions.
FUEL INJECTION	Monitors for fuel injection system malfunctions that result in emissions exceeding 1.5 times federal emission standards.
FRONT AND REAR O2 SENSORS	Front O2 Sensor: O2 sensor voltage and abnormal response time are used to determine if emissions exceed 1.5 times federal emission standards. Rear O2 Sensor: O2 sensor voltage and response time are assigned standard values. These values are used as monitors to determine system malfunction. Values exceeding these standards set a Diagnostic Trouble Code (DTC).
EGR SYSTEM	Monitors increases or decreases in flow volume that indicate EGR system malfunction, resulting in emissions exceeding 1.5 times federal emission standards.
EVAP SYSTEM	Detects leakage caused by a 0.040 inch or larger hole in the EVAP system. Allowable leakage to be further reduced in future OBD generations. In addition, the system monitors purge flow during specific driving conditions.

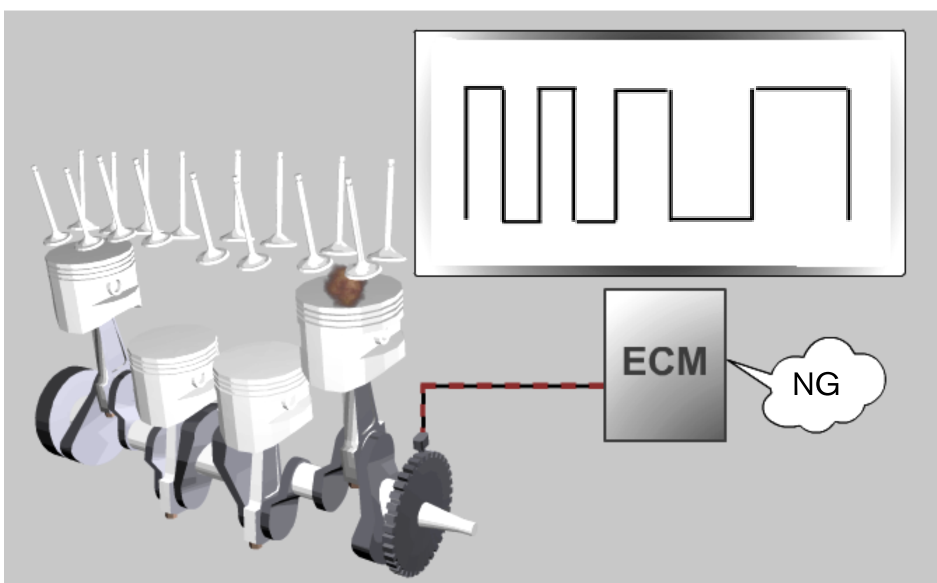
Three Way Catalyst

The 3-Way Catalyst cleans the exhaust, reducing harmful emissions. Nissan and Infiniti use Rear O2 sensors to evaluate the condition of the catalyst. If the catalyst fails to store enough oxygen to reduce vehicle emissions, a DTC will set and the SES lamp will illuminate.



Misfire Detection

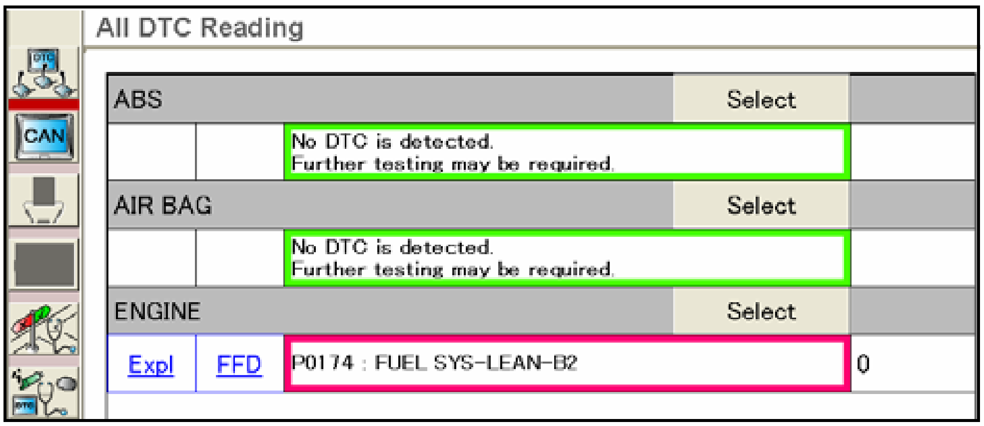
If the engine develops a misfire, OBD II regulations require that the SES lamp be turned On immediately, or even blink to indicate the catalytic converter might be damaged if the vehicle is driven under heavy engine loads.



The Crankshaft Position Sensor (CKP - POS) senses crankshaft speed. If one cylinder has a misfire, it will not generate the same signal as the normal cylinders. the CKP sensor will send this signal to the ECM and a Misfire DTC will be set for the weak cylinder. In this example of a 4 cylinder engine, P0301 would be set for a misfire on the number 1 cylinder.

Fuel Injection System

If the mixture is unusually lean or rich, OBD II regulations require that the ECM set a code. Air Fuel Alpha is the indication used by the ECM to detect problems with the fuel injection system. If the Alpha reading remains below 90% for extended periods, the ECM may set a code for 'Fuel System Rich'. Fuel System Lean DTCs can be set of the Alpha readings remain above 110% for extended periods.



This screen print shows a DTC set if Bank 2 is running lean.

The ESM lists items to check: air leaks, A/F sensors, fuel injectors, exhaust leaks or fuel pressure could cause this DTC.

Front and Rear O2 Sensors and A/F Sensors

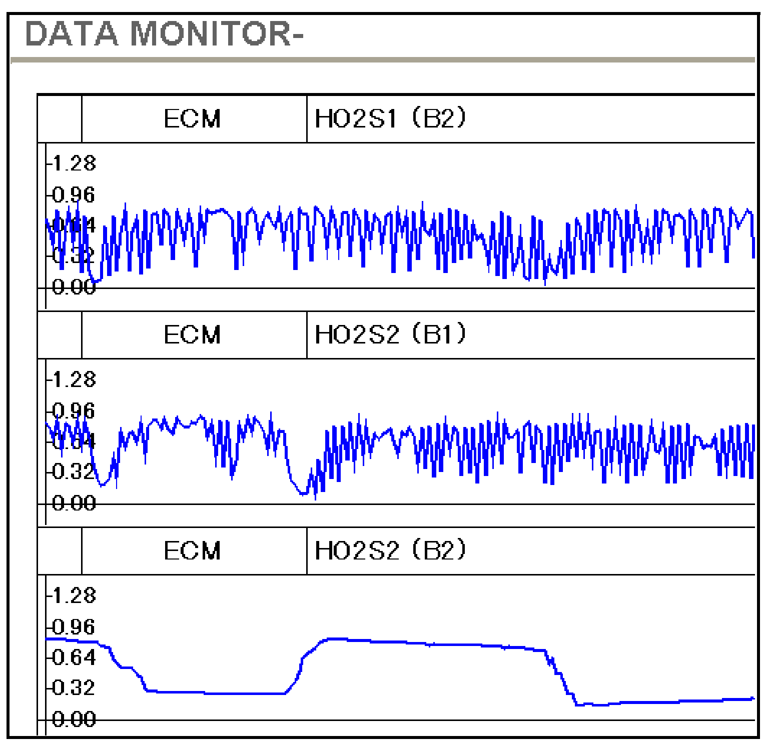
Older vehicles with Front O2 sensors and current models with A/F sensors use these sensors to provide the ECM feedback signals necessary to control the air / fuel mixture. Rear O2 sensors result from OBD II regulations requiring manufacturers to monitor catalyst performance.

The top CONSULT-III Data Monitor graph illustrates a Front O2 sensor cycling from high to low voltage. The frequency of the cycling indicates the sensor is working properly.

The middle graphic shows the Bank 1 Rear O2 sensor cycling very quickly. The sensor is OK, it cycles from low to high voltage, but the catalytic converter has failed.

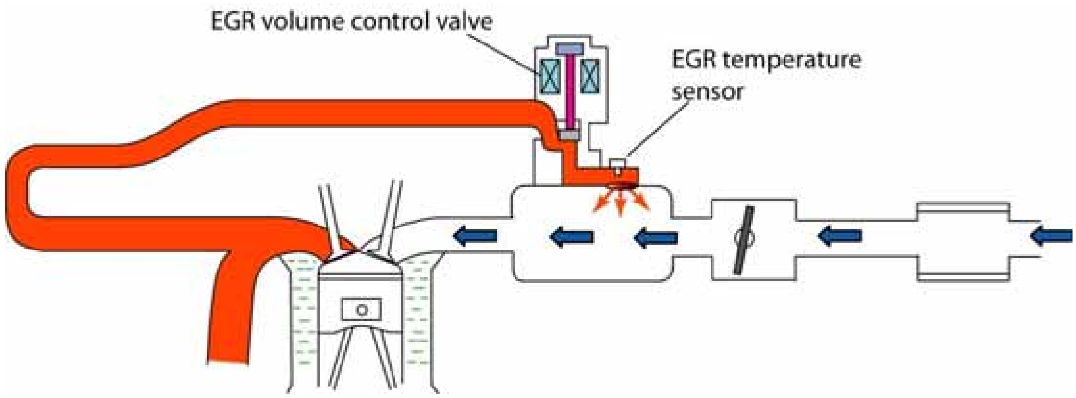
The Bank 2 Rear O2 sensor cycles very slowly, indicating that the B2 catalyst has adequate oxygen storage capacity and is OK.

The ECM measures the frequency of Rear O2 sensor cycles to judge the catalytic converter.



Exhaust Gas Recirculation (EGR) Systems

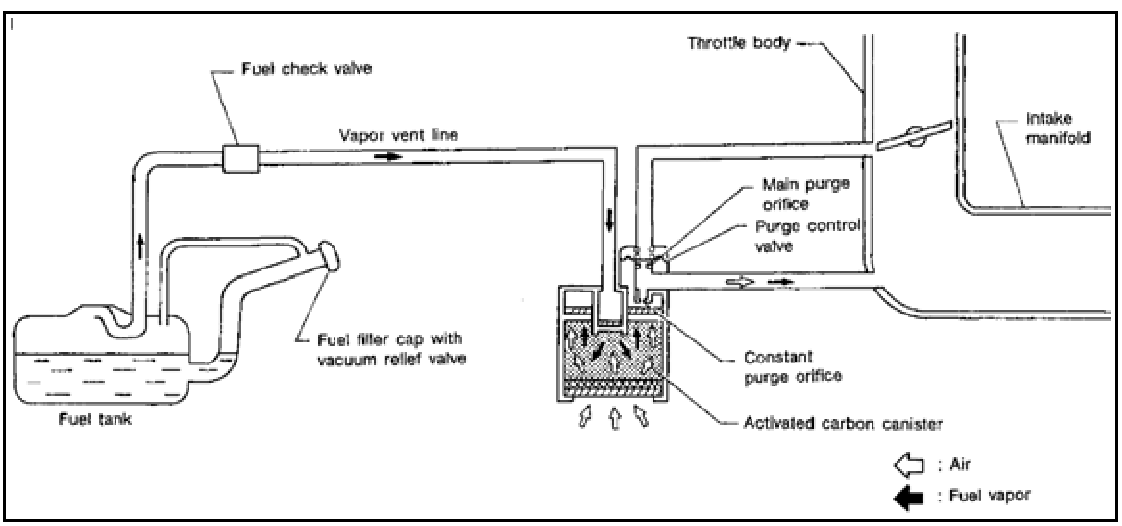
EGR systems feed a small amount of exhaust gas into the intake manifold to dilute the air fuel mixture when the vehicle is cruising under a light to moderate load. This causes the mixture to burn at a lower temperature. Oxides of Nitrogen (NOx) emissions result from high combustion temperatures, so the EGR system was designed to reduce NOx emissions.



Nissan and Infiniti vehicles have been phasing out EGR controls. The Nissan Quest is the only 2009 model that features EGR controls. Systems such as Intake Valve Timing (IVT) control have reduced the need for EGR systems. When OBD II first required the reduction of NOx, most manufacturers relied on EGR controls to lower combustion temperatures. OBD II regulations in the 1990 Clean Air Act required these systems be monitored for failures. The ECM will set a number of possible DTCs if the EGR system is not functioning properly.

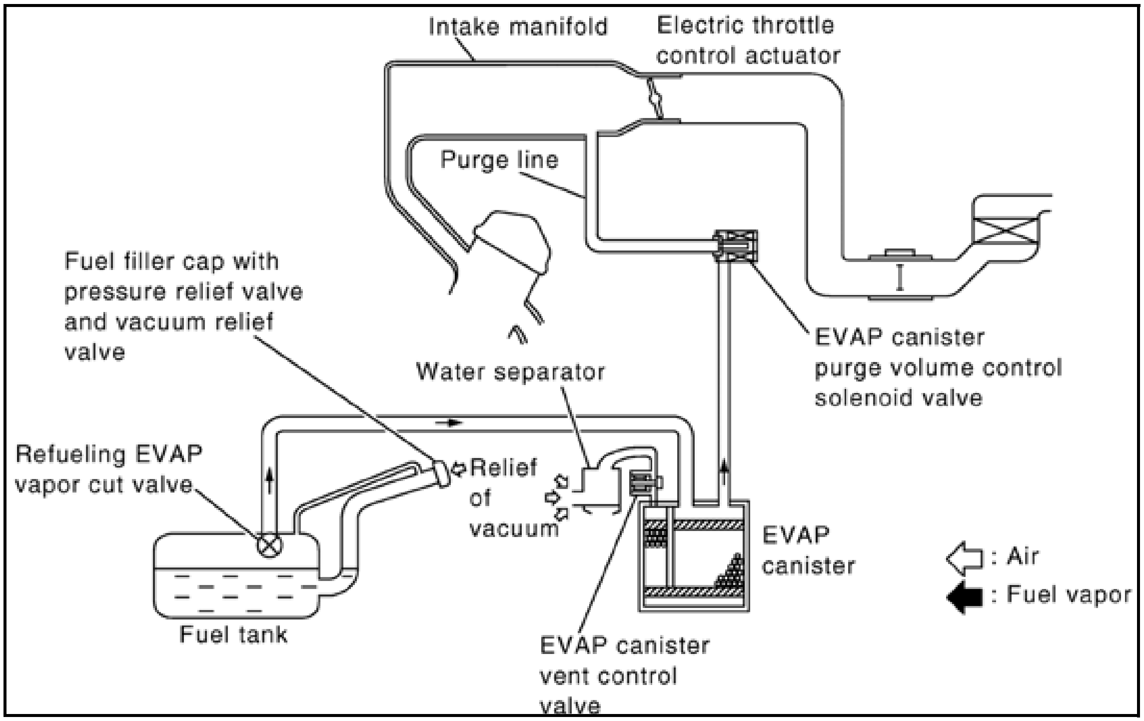
Evaporative Emissions Systems

Many changes to Nissan and Infiniti Evaporative System controls were required as a result of OBD II regulations. Early Evap systems required a canister and purge control valve.



The canister stored fuel vapors and purged them through the intake manifold. The ECM did not monitor or diagnose problems with the canister or vapor storage components.

OBD II regulations required that manufacturers confirm that the fuel storage system could not leak hydrocarbon (HC) fuel vapors in to the atmosphere. This required an elaborate system of controls.



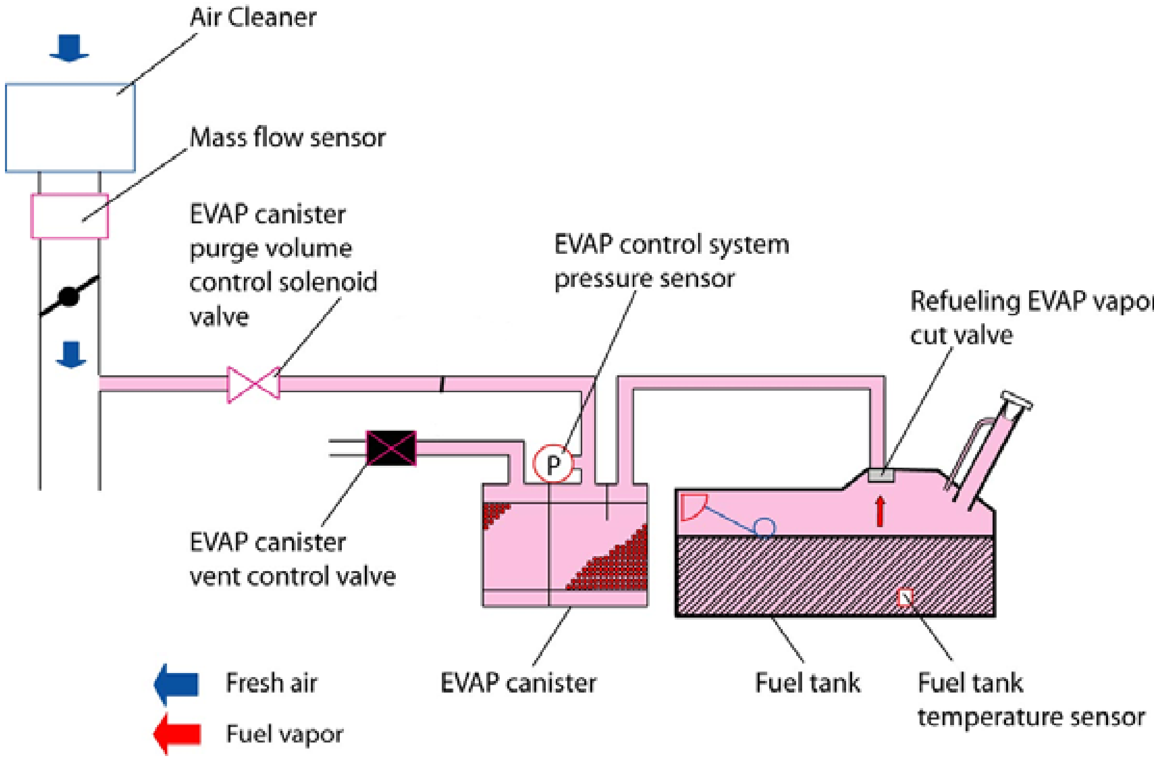
Evaporative systems required the following components to meet emissions standards when OBD II regulations took effect in 1996:

- Large Capacity Charcoal Canister - required to hold more fuel vapor
- Sealing Fuel Filler Cap - the cap needed to seal the tank, but have vacuum and pressure reliefs for safely purposes
- Purge Control Solenoid Valve - the ECM controlled and monitored the purge control solenoid valve to insure that the system purged fuel vapors at the correct time
- Evap Canister Vent Control Solenoid Valve - this valve was required so that the ECM could close the canister vent and check the evap system for leaks
- Evaporative Pressure Sensor (not shown) - the evap pressure sensor is the critical input to the ECM to confirm that the system is not leaking and the vapor purge is occurring at the proper time

The Evaporative System Controls for Nissan and Infiniti vehicles all include these basic components and some vehicles had more sophisticated controls to precisely control fuel vapor leaks and purge controls.

As much as 20% of hydrocarbon pollution was caused by the Evaporative System before the Clean Air Act requirements which took effect in the 1996.

Purge Flow Monitoring and Leak Testing



This graphic illustrates how the fuel tank directs vapor to the EVAP canister. Once the ECM determines that the engine is at operating temperature and moving under a light to moderate load, the Purge Control Solenoid valve will open to allow vapor to purge into the intake manifold.

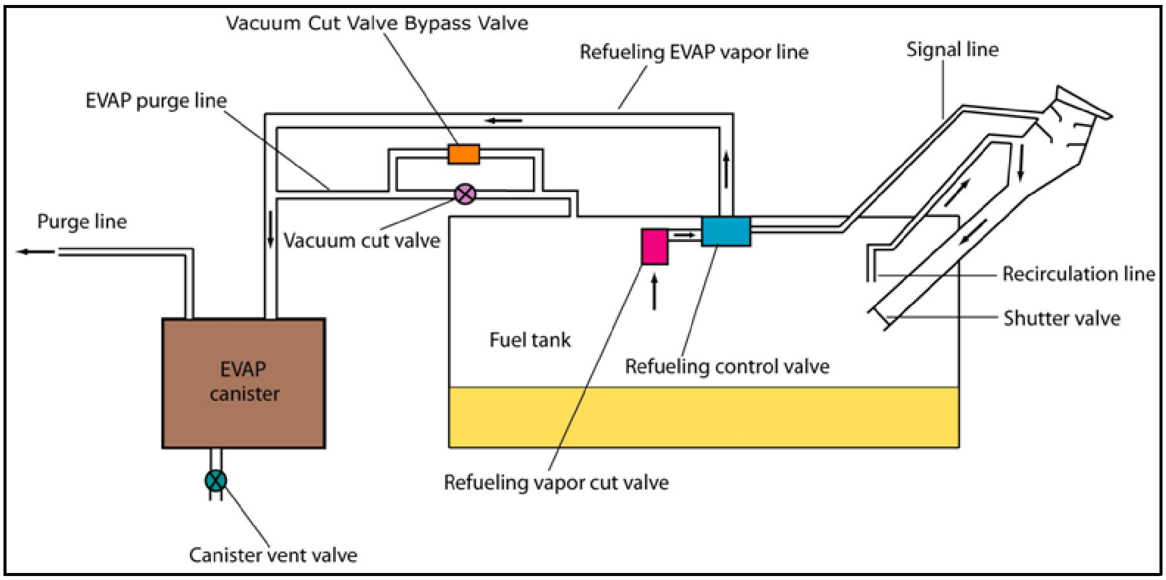
When conditions warrant, the ECM will close the purge valve and EVAP canister Vent Control valve and monitor the EVAP Control System Pressure sensor. During this procedure, a DTC for a Evap system leak will be set if the pressure sensor indicates the canister does not hold pressure or vacuum.

On-Board Fuel Vapor Recovery (ORVR) System

ORVR systems are not part of the engine controls managed by the ECM. The ORVR system is required by OBD II regulations and is combined with the evaporative controls found on Nissan and Infiniti vehicles.

On-board vapor recovery systems direct fuel vapors stored in the tank into the canister when the vehicle is being re-fueled.

If this system has a failure, possible symptoms are a fuel smell or difficulty refilling the tank with fuel.



The ORVR System for Nissan and Infiniti vehicle may contain the following components:

- Refueling Control Valve: When the vehicle is refueled, the filler neck and tank are designed to prevent vapor from escaping. The Refueling Control Valve must open to allow vapor to pass from the fuel tank to the charcoal canister where it is stored until the system purges.
- Refueling Vapor Cut Valve: The system shown above includes a vapor cut valve which will close when fuel has filled the tank. This will prevent any fuel from being pumped into the canister.
- Signal Line: This older ORVR system features a signal line that must sense a slight vacuum in order for the refueling control valve to open. Fuel flowing through the filler neck produces this slight vacuum.

Current model vehicles do not have a Signal Line as part of the ORVR system. All Nissan and Infiniti vehicles after the 2000 model year have the refueling valves inside the fuel tank. Check ASIST if you believe you have a ORVR problem. In most circumstances, if a refueling control or cut valve are faulty, the fuel tank must be replaced.

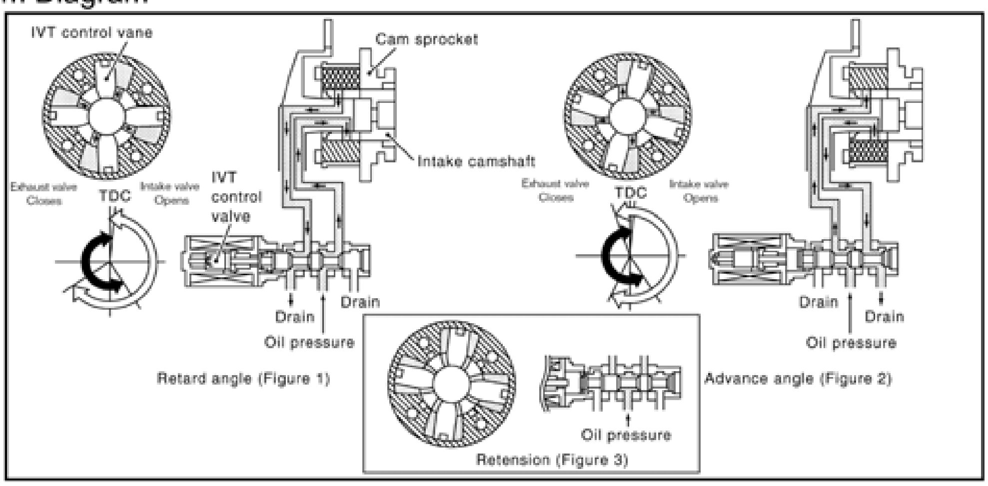
Engine Control Systems Review

Intake and Exhaust Camshaft Timing Systems

Nissan and Infiniti have used Intake and Exhaust camshaft timing systems to both limit emissions and increase engine power. Intake Valve Timing (IVT) controls advance the intake cam as RPM and engine loads increase. This causes the intake valves to open before the exhaust valves close. Valve overlap is the number of degrees when both intake and exhaust valves are open. Increasing valve overlap increases engine power and efficiency. Since a small amount of exhaust gas mixes with air and fuel entering the combustion chamber, peak combustion temperatures are reduced helping to control NOx emissions.

INTAKE VALVE TIMING CONTROL

System Diagram



Intake Camshaft controls were introduced on the Infiniti Q45 as Valve Timing Controls (VTC), and are hydraulically controlled like the IVT system shown in the graphic. Some models called this system CVTC or Continuously Variable camshaft Timing Controls.

All Nissan and Infiniti IVT systems use oil pressure to control intake camshaft advance. The ECM duty cycles a solenoid based on the inputs shown to direct oil pressure to actuator assembly.

System Description

INPUT/OUTPUT SIGNAL CHART

Sensor	Input signal to ECM	ECM function	Actuator
Crankshaft position sensor (POS)	Engine speed and piston position	Intake valve timing control	Intake valve timing control solenoid valve
Camshaft position sensor (PHASE)			
Engine coolant temperature sensor	Engine coolant temperature		
Unified meter and A/C amp.	Vehicle speed*		

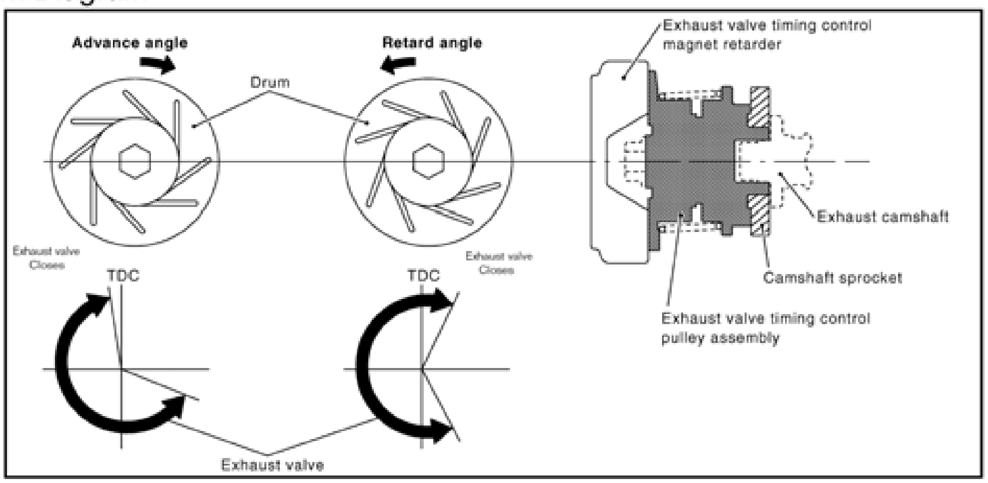
*: This signal is sent to the ECM through CAN communication line

Exhaust Camshaft Timing Controls

Exhaust Valve Timing (EVT) controls were first used on the 2005 VQ35VHR engines featured in the 350Z and G35. This system uses an electromagnetic clutch to retard the exhaust cam when engine RPM or loads increase.

EXHAUST VALVE TIMING CONTROL

System Diagram



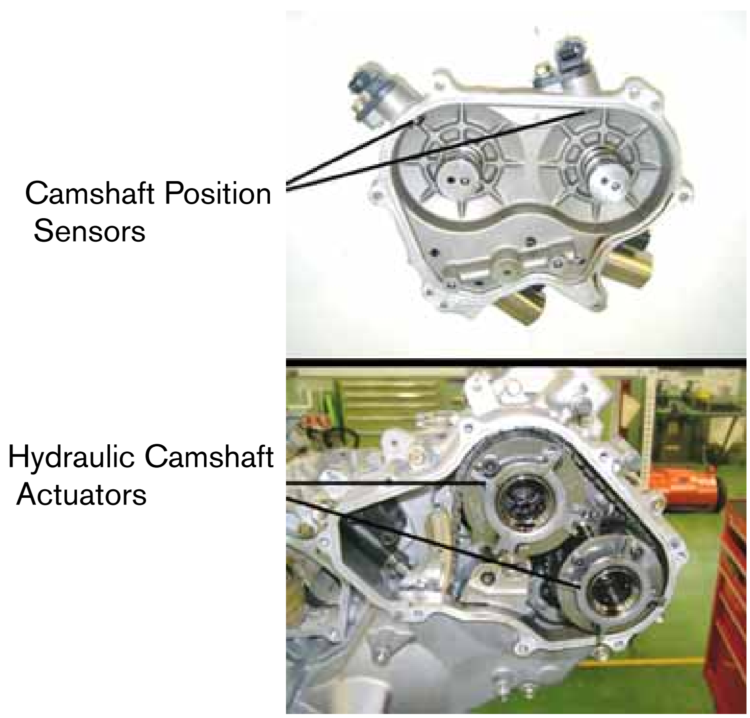
Retarding the exhaust cam increases valve overlap by allowing the exhaust valve to remain open longer as the intake valve begins to open. Used in combination with the IVT system, some models have as much as 70 degrees of valve overlap. Continuously adjusting intake and exhaust camshaft timing enables the vehicle to have a smooth idle speed and increased power without sacrificing fuel economy or low emissions.

The 2009 Infiniti FX50 features a 5.0 liter V8 engine.

This engine features both intake and exhaust camshaft timing controls.

The VK50VE engine uses hydraulic controls for both intake advance and exhaust retard functions.

The ECM controls all Nissan and Infiniti camshaft timing systems, and will set a variety of possible DTCs if the system is malfunctioning.



Variable Valve Event and Lift (VVEL)

This system, like IVT and EVT, is designed to limit vehicle emissions and improve power. The VVEL was first featured on the 2008 G35 and the 2009 370Z is also equipped with this system.

At low RPM and engine loads, the intake valve lift is minimized. This improves idle quality and lowers emissions. Once the RPM or engine loads are increased, VVEL controls open the intake valves as necessary to enable these performance engines to produce peak power.

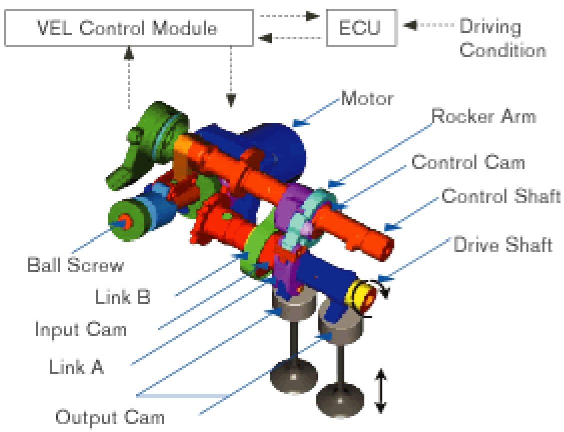
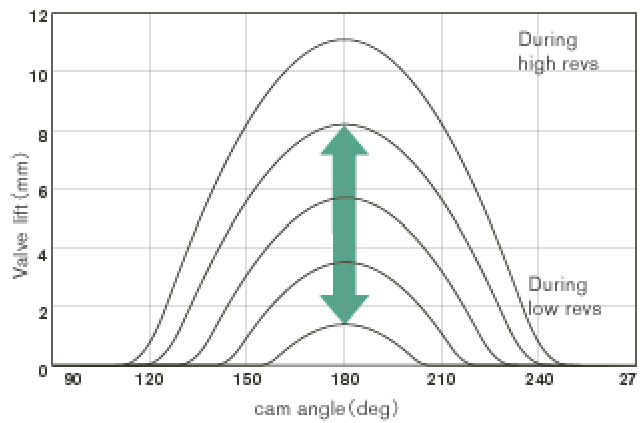


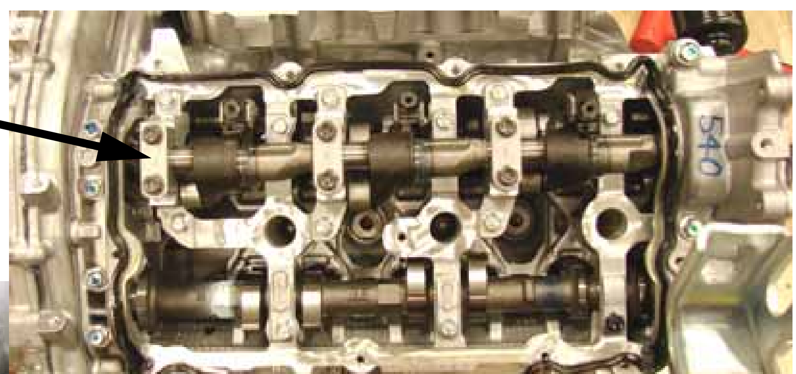
Diagram of VEL structure



Valvelift characteristics

The ECM signals the VVEL Control Module when driving conditions require the valve lift be increased or decreased. The VVEL module will send current to a DC motor that rotates a control shaft. Intake valve lift can be as low as 2 millimeters and as high as 11 millimeters based on engine loads.

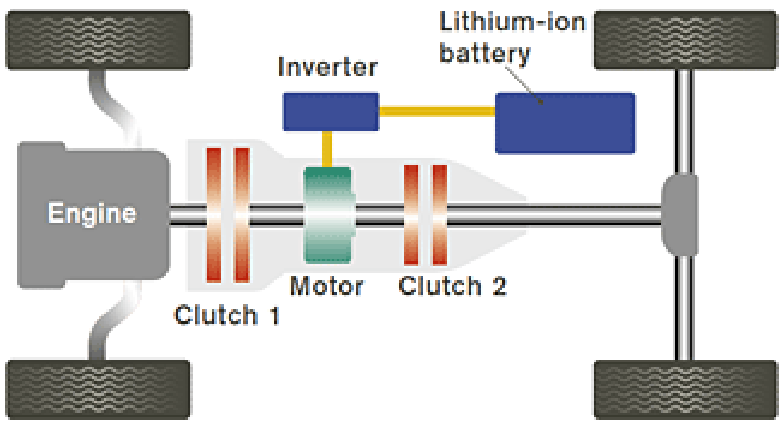
The VVEL 'Ladder' assembly controls intake valve lift. This ladder cannot be serviced.



The VVEL Control Shaft Position sensor provides precise feedback to the ECM to enable control of intake valve lift. The sensor should not be adjusted unless it has been replaced.

ECCS and Engine Control Developments

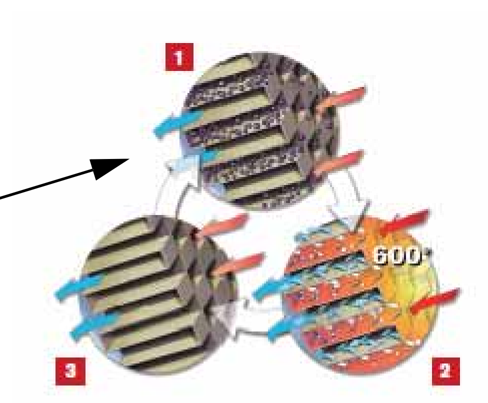
The Electronic Concentrated engine Control System has adapted to changes in technology and emissions regulations for several decades. Hybrid vehicles are powered by ECCS engines and electric motors.



Nissan continues testing various types of hybrid vehicles such as the rear drive system shown in this schematic drawing.

Clean diesel technology is developed for future use in Nissan vehicles.

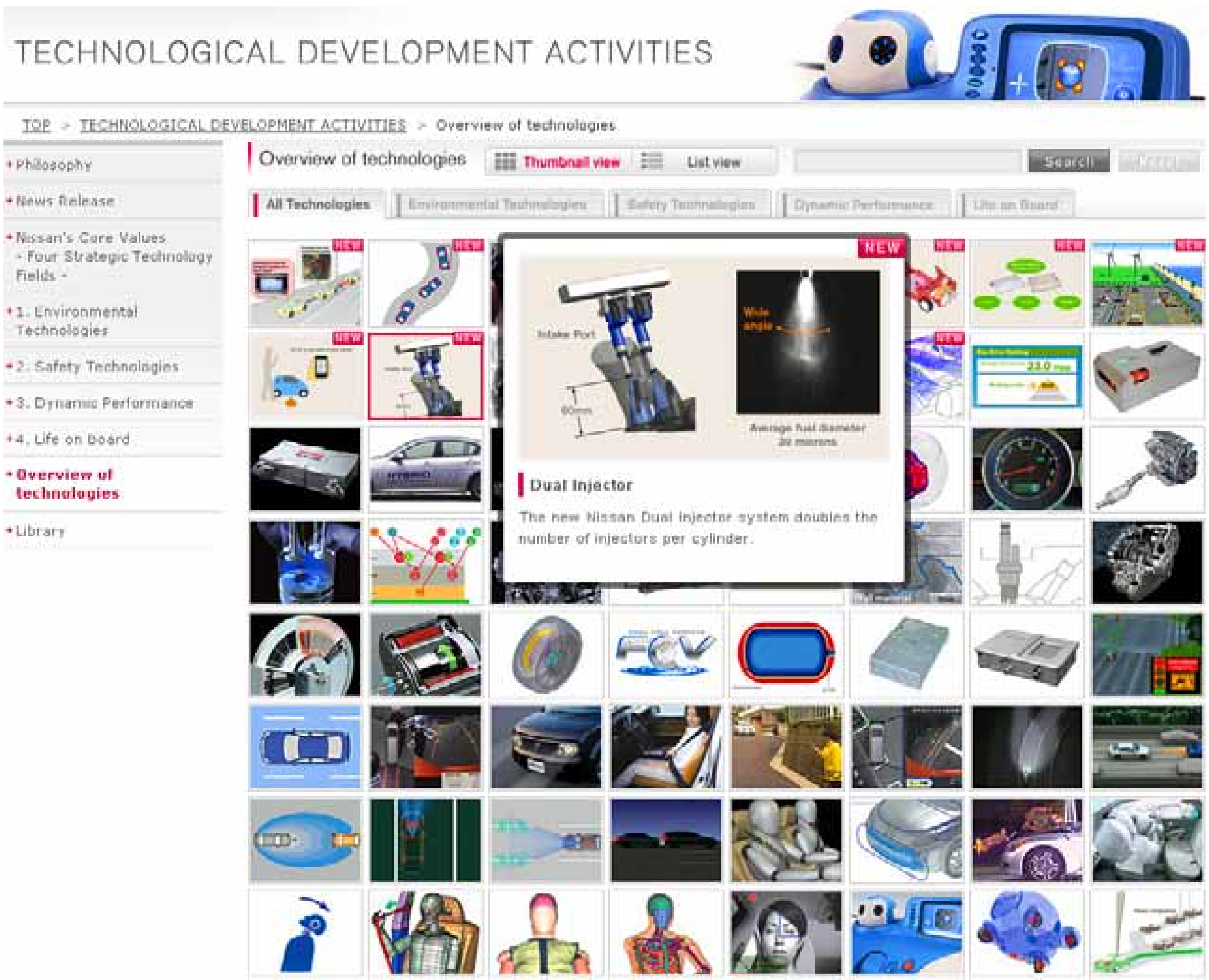
Double Swirl ports improve diesel combustion efficiency. Nissan's clean diesel meets California's SULEV emissions standards.



The design of Nissan's Diesel Particulate Filter (DPF) controls diesel emissions. The filter design enables it to regenerate and continue to clean diesel exhaust.

Flex Fuel Engines are featured on several Nissan vehicles.

E85 fuel is 85% Ethanol and can be used on selected Titan vehicles. Bio-fuels such as E85 produce less CO_2 during the combustion process reducing green house gas emissions. Nissan has introduced an E100 vehicle in Brazil that can run on 100% ethanol fuel.



Visit this web address to see the technologies being developed for Nissan and Infiniti vehicles.

http://www.nissan-global.com/EN/TECHNOLOGY/INTRODUCTION/