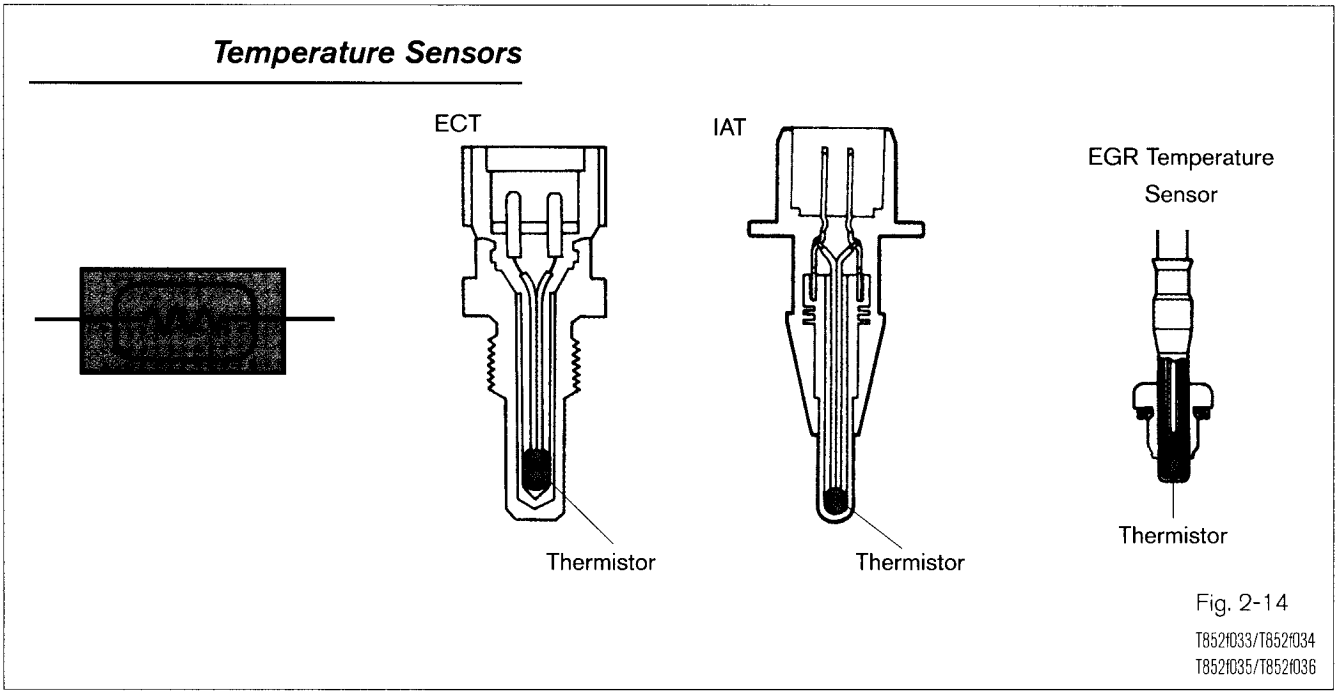


Fig. 2-14

T852f033/T852f034
T852f035/T852f036

Temperature Sensors

The ECM needs to adjust a variety of systems based on temperatures. It is critical for proper operation of these systems that the engine reach operating temperature and the temperature is accurately signaled to the ECM. For example, for the proper amount of fuel to be injected the ECM must know the correct engine temperature. Temperature sensors measure Engine Coolant Temperature (ECT), Intake Air Temperature (IAT) and Exhaust Recirculation Gases (EGR), etc.

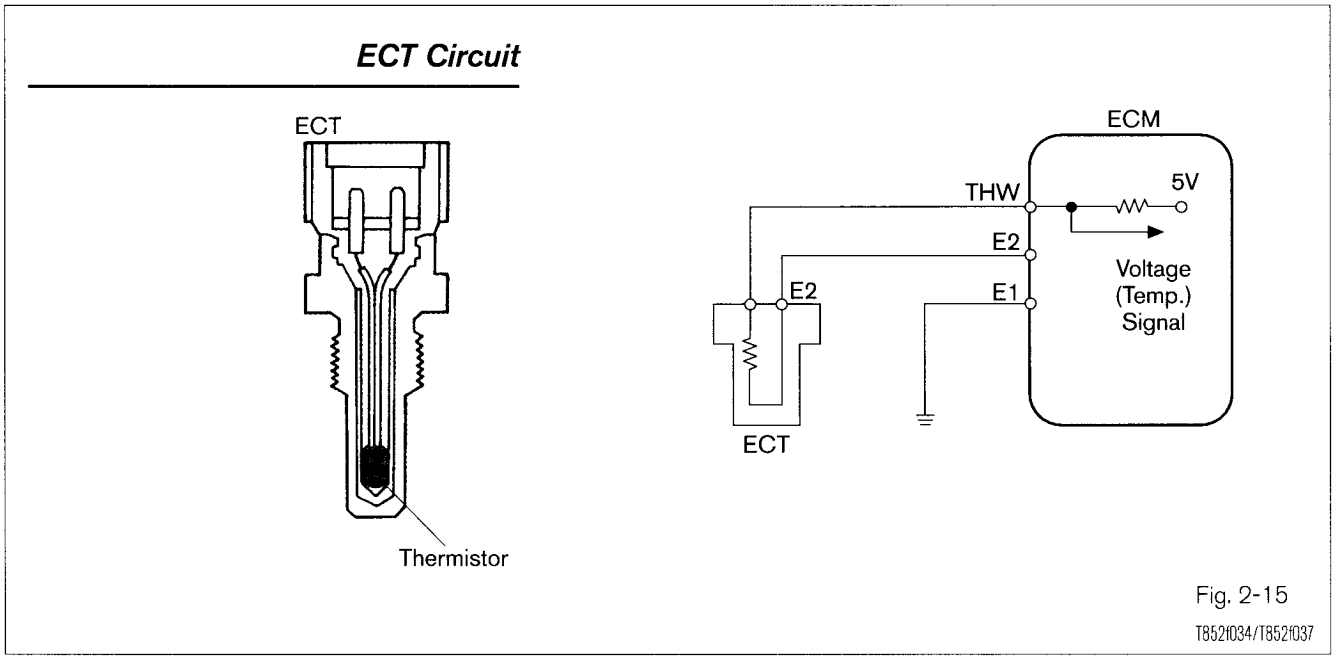


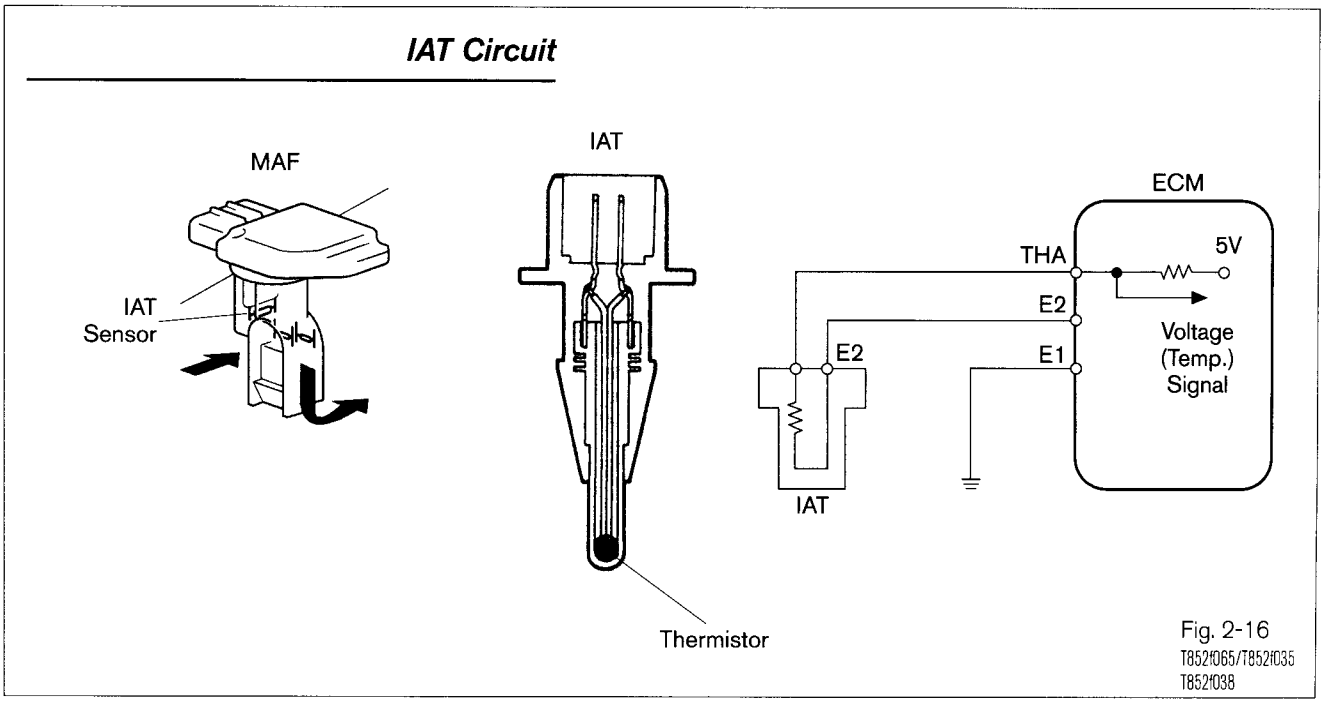
Fig. 2-15

T852f034/T852f037

Engine Coolant Temperature (ECT) Sensor

The ECT responds to change in Engine Coolant Temperature. By measuring engine coolant temperature, the ECM knows the average temperature of the engine. The ECT is usually located in a coolant passage just before the thermostat. The ECT is connected to the THW terminal on the ECM.

The ECT sensor is critical to many ECM functions such as fuel injection, ignition timing, variable valve timing, transmission shifting, etc. Always check to see if the engine is at operating temperature and that the ECT is accurately reporting the temperature to the ECM.



Intake Air Temperature (IAT) Sensor

The IAT detects the temperature of the incoming air stream. On vehicles equipped with a MAP sensor, the IAT is located in an intake air passage. On Mass Air Flow sensor equipped vehicles, the IAT is part of the MAF sensor. The IAT is connected to the THA terminal on the ECM. The IAT is used for detecting ambient temperature on a cold start and intake air temperature as the engine heats up the incoming air.

NOTE: One strategy the ECM uses to determine a cold engine start is by comparing the ECT and IAT signals. If both are within 8'C (15'F) of each other, the ECM assumes it is a cold start. This strategy is important because some diagnostic monitors, such as the EVAP monitor, are based on a cold start.

EGR Temperature Circuit

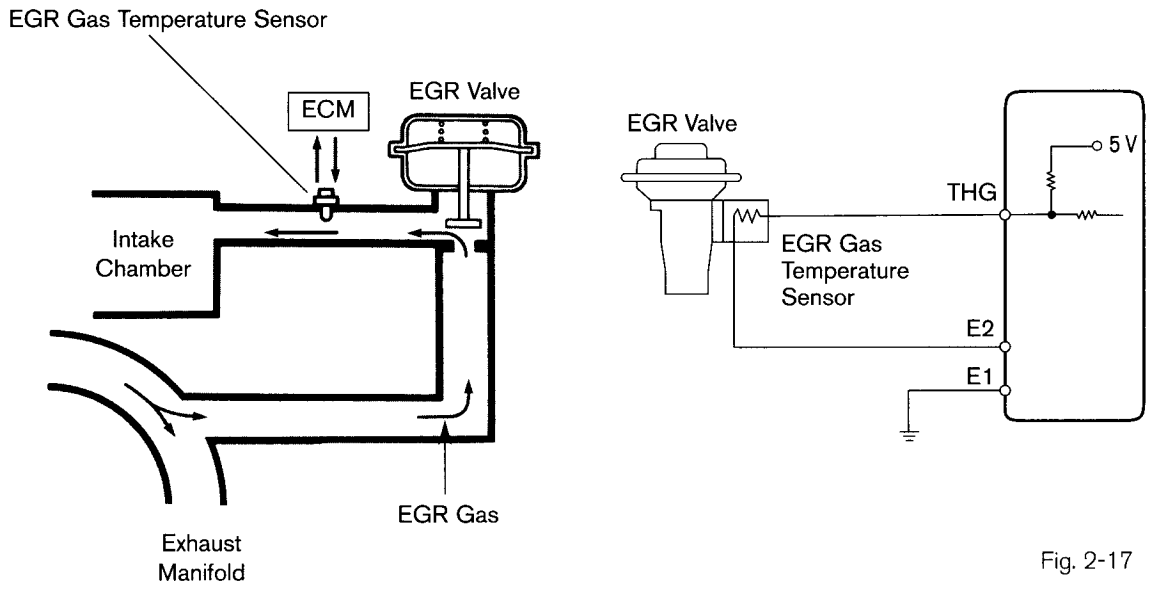


Fig. 2-17
T852f039/T852f040

Temperature Graph

As temperature increases, sensor resistance and the voltage signal decreases. Note that at the upper end of the temperature/resistance scale, ECT resistance changes very little.

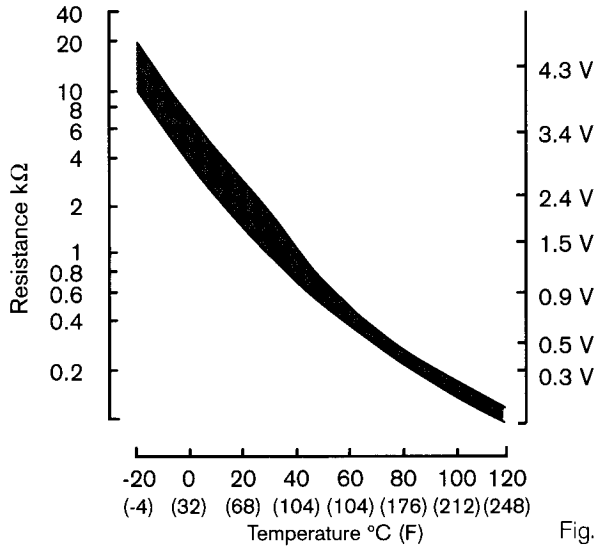


Fig. 2-18
T852f041

Exhaust Gas Recirculation (EGR) Temperature Sensor

The EGR Temperature Sensor is located in the EGR passage and measures the temperature of the exhaust gases. The EGR Temp sensor is connected to the THG terminal on the ECM. When the EGR valve opens, temperature increases. From the increase in temperature, the ECM knows the EGR valve is open and that exhaust gases are flowing.

ECT, IAT, & EGR Temperature Sensor Operation
Though these sensors are measuring different things, they all operate in the same way. From the voltage signal of the temperature sensor, the ECM knows the temperature. As the temperature of the sensor heats up, the voltage signal decreases. The decrease in the voltage signal is caused by the decrease in resistance. The change in resistance causes the voltage signal to drop.

The temperature sensor is connected in series to a fixed value resistor. The ECM supplies 5 volts to the circuit and measures the change in voltage between the fixed value resistor and the temperature sensor.

When the sensor is cold, the resistance of the sensor is high, and the voltage signal is high. As the sensor warms up, the resistance drops and voltage signal decreases. From the voltage signal, the ECM can determine the temperature of the coolant, intake air, or exhaust gas temperature.

The ground wire of the temperature sensors is always at the ECU usually terminal E2. These sensors are classified as thermistors.

Temperature Sensor Diagnostics
Temperature sensor circuits are tested for:

- opens.
- shorts.
- available voltage.
- sensor resistance.

The Diagnostic Tester data list can reveal the type of problem. An open circuit (high resistance) will read the coldest temperature possible. A shorted circuit (low resistance) will read the highest temperature possible. The diagnostic procedure purpose is to isolate and identify the temperature sensor from the circuit and ECM.

High resistance in the temperature circuit will cause the ECM to think that the temperature is colder than it really is. For example, as the engine warms up, ECT resistance decreases, but unwanted extra resistance in the circuit will produce a higher voltage drop signal. This will most likely be noticed when the engine has reached operating temperatures. Note that at the upper end of the temperature/resistance scale, ECT resistance changes very little. Extra resistance in the higher temperature can cause the ECM to think the engine is approximately 20'F = 30'F colder than actual temperature. This will cause poor engine performance, fuel economy, and possibly engine overheating.

Solving Open Circuit Problems

A jumper wire and Diagnostic Tester are used to locate the problem in an open circuit.

Open Circuit Test at Sensor

A jumper wire is inserted in the circuit as shown in the Repair Manual; the temperature should go high (hot). If it does, the circuit and the ECM must be good, and the temperature sensor or connector is at fault.

If the temperature did not go high (hot), then the problem is with the circuit or ECM.

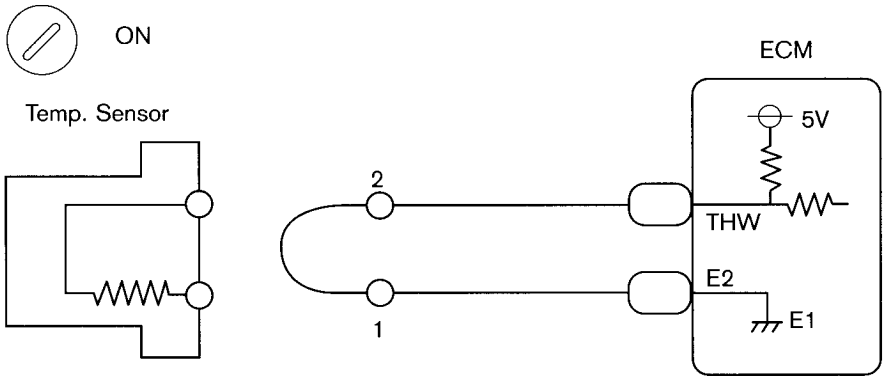


Fig. 2-19
T852f042

Open Circuit Test at ECM

To isolate if the problem is with the circuit or the ECM, a jumper wire is inserted between the temperature (such as THW) terminal and ground (E2), and the temperature should go high. If it does, the problem is in the circuit. If it did not go high, the fault is either in the connection or ECM.

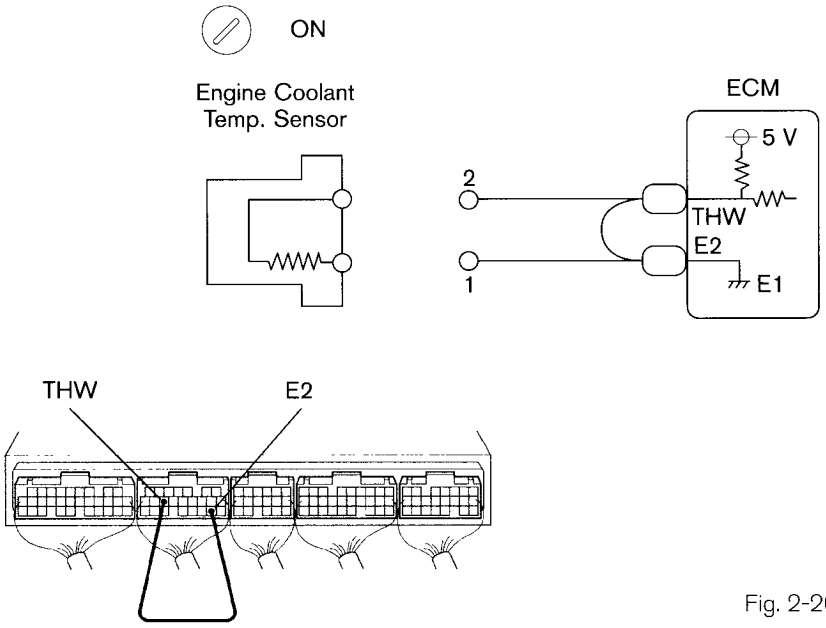


Fig. 2-20
T852f043/T852f044

Solving Shorted Circuit Problems

Creating an open circuit at different points in the temperature circuit will isolate the short. The temperature reading should go extremely low (cold) when an open is created.

Short Circuit Testing

To confirm if the circuit or ECM is at fault, first disconnect the connector at the ECM. Temperature should go low (cold). If it does, the harness or connector is at fault. If not, the problem is with the ECM.

Disconnecting the connector at the ECT should cause the temperature reading to go low (cold). If it does, the problem is in the sensor. If not, the problem is in the circuit harness.

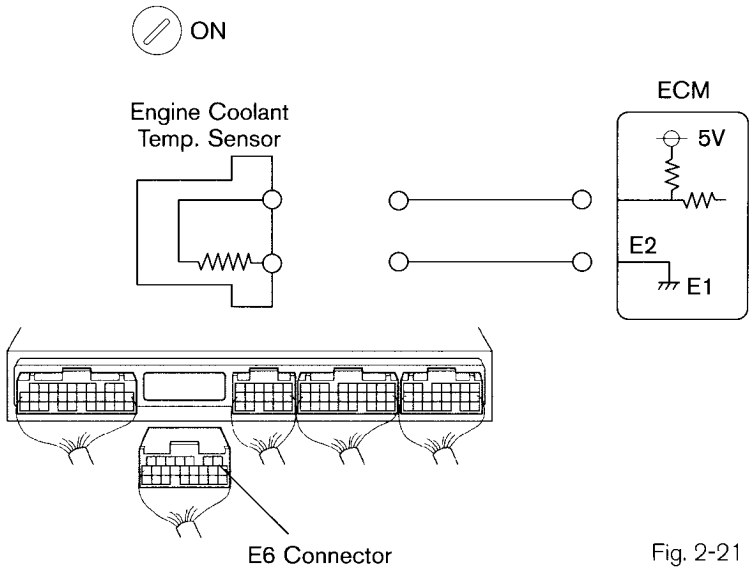


Fig. 2-21

T852f045/T852f046

Temperature Sensor Component Testing

A temperature sensor is tested for accuracy by comparing the resistance of the sensor to the actual temperature. The RM contains the procedure and specifications. To insure accuracy, you must have an accurate thermometer and good electrical connections to the DVOM.

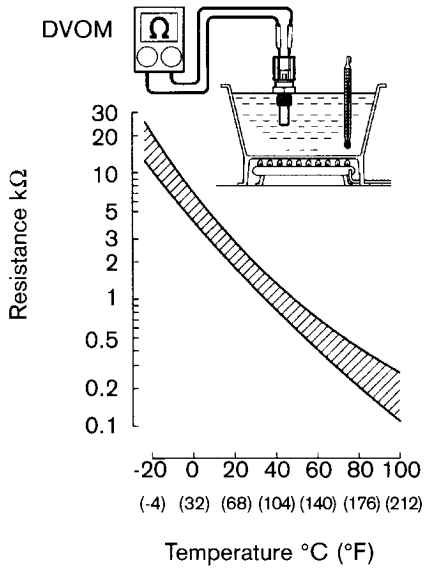


Fig. 2-22

T852f047

ASSIGNMENT **NAME:** _____

1. List the three types of temperature sensors used and explain the function of each?

2. Temperature sensors are actually _____?

3. Draw a sample temperature sensor circuit. (Label all parts)

4. The ECT us used by the computer to control what functions?

5. What PCM strategy is used when both the IAT and ECT are within 15'F of each other?

6. Temperature sensors are tested for:

7. Describe the procedure of testing a temperature sensor.

