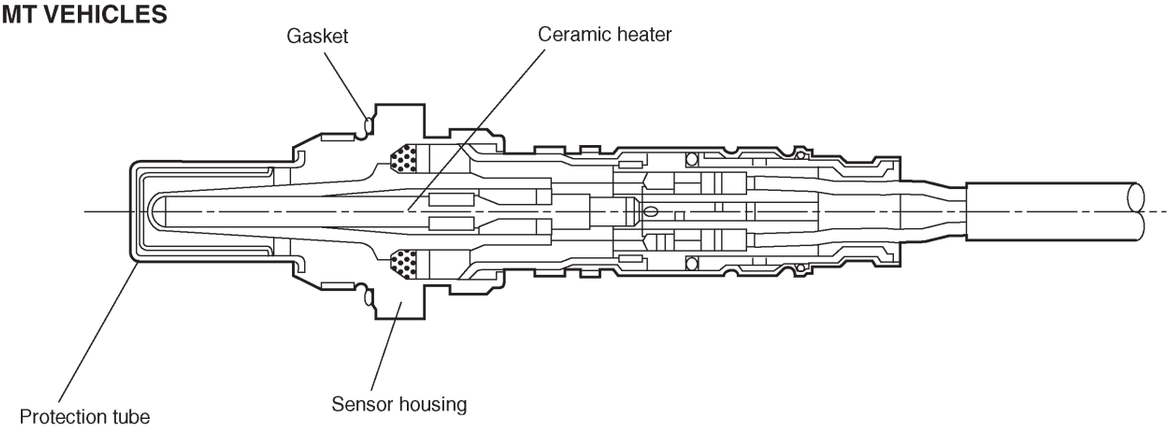
5. Sensor and Switch

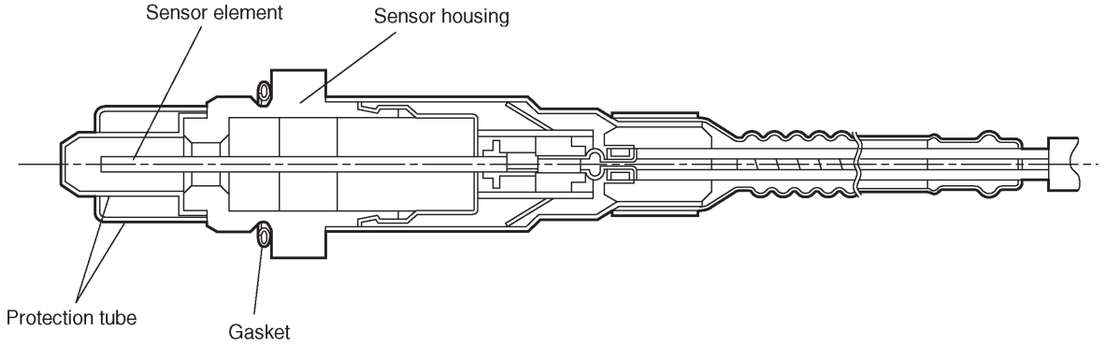
A: FRONT OXYGEN (A/F) SENSOR

- The front oxygen (A/F) sensor uses zirconium oxide (ZrO_2) which is a solid electrolyte, at portions exposed to exhaust gas.
- The zirconium oxide has the property of generating electromotive force when contacting an oxygen ion, and the electromotive force generated varies depending on the amount of oxygen ion.
- The front oxygen (A/F) sensor detects the amount of oxygen in exhaust gases in a linear form by making use of this property. The sensor housing is grounded to the exhaust pipe, and the inside is connected to the ECM through the harness.
- A ceramic heater is employed to improve performance at low temperature.

MT VEHICLES



AT VEHICLES

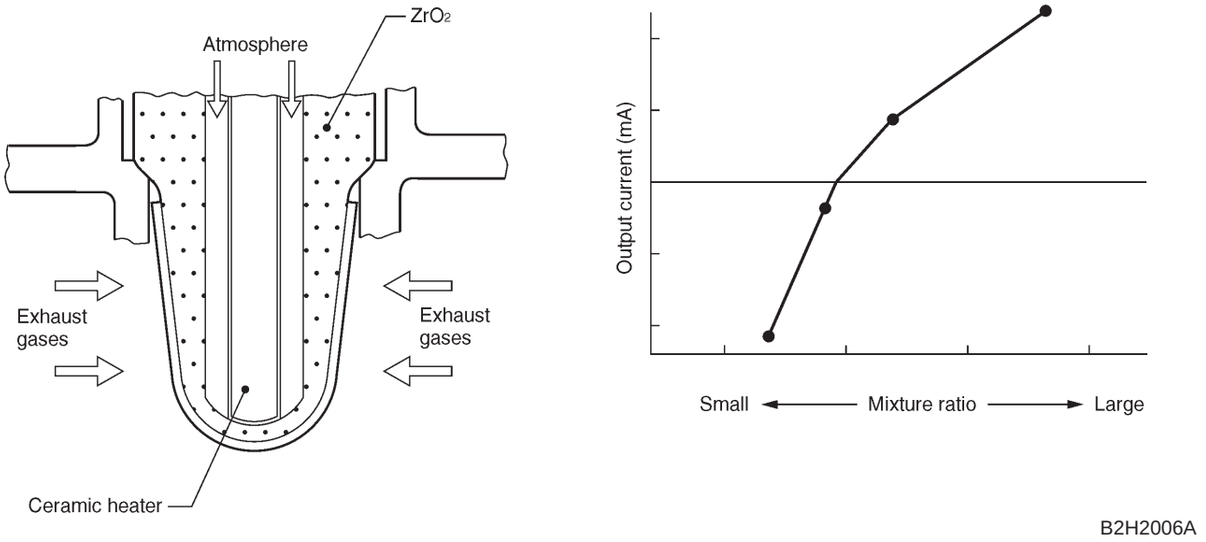


B2H3443A

● When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases reacts almost completely through the catalytic action of the platinum coating on the surface of the zirconia tube. This results is a very large difference in the oxygen concentration between the inside and outside, and the electromotive force generated is large.

● When a lean air-fuel mixture is burnt in the cylinder, oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen concentration. The electromotive force is very small.

● The difference in oxygen concentration changes greatly in the vicinity of the optimum air-fuel ratio, and hence the change in the electromotive force is also large. By inputting this information into the ECM, the air-fuel ratio of the supplied mixture can be determined easily. The front oxygen (A/F) sensor does not generate much electromotive force when the temperature is low. The characteristics of the electromotive force stabilize at temperature of approximately 700°C (1,292°F).

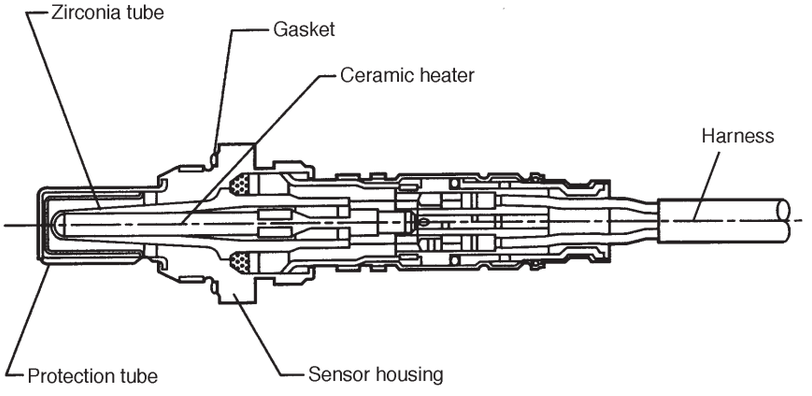


B2H2006A

B: REAR OXYGEN SENSOR

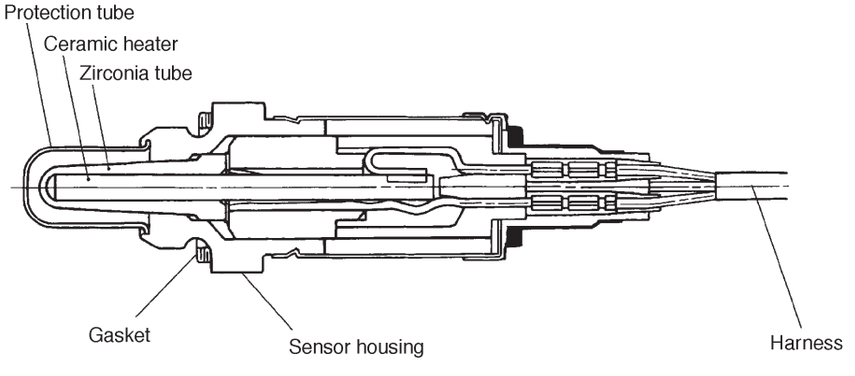
- The rear oxygen sensor is used to sense oxygen concentration in the exhaust gas. If the fuel ratio is leaner than the stoichiometric ratio in the mixture (i.e. excessive amount of air), the exhaust gas contains more oxygen. To the contrary, if the fuel ratio is richer than the stoichiometric ratio, the exhaust gas contains hardly any oxygen.
- Therefore, examination of the oxygen concentration in exhaust gas makes it possible to show whether the air/fuel ratio is leaner or richer than the stoichiometric ratio.
- The rear oxygen sensor has a zirconia tube (ceramic) which generates voltage if there is a difference in oxygen concentration between the inside and outside of the tube. Platinum is coated on the inside and outside of the zirconia tube for the purpose of catalysis and electrode provision. The sensor housing is grounded to the exhaust pipe, and the inside is connected to the ECM through the harness.
- A ceramic heater is employed to improve performance at low temperature.

MT VEHICLES



B2H1993B

AT VEHICLES

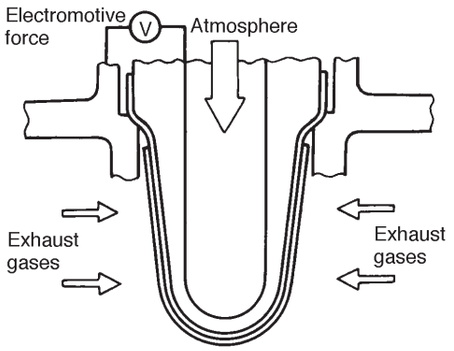


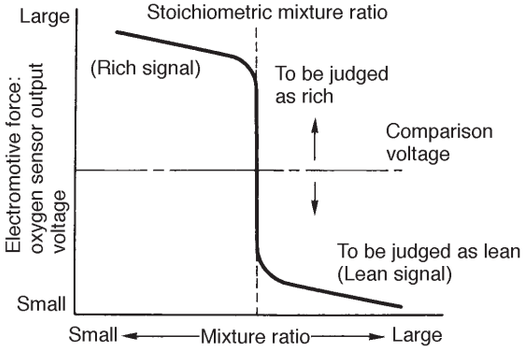
B2H3810A

● When rich air-fuel mixture is burnt in the cylinder, the oxygen in the exhaust gases reacts almost completely through the catalytic action of the platinum coating on the surface of the zirconia tube. This results is a very large difference in the oxygen concentration between the inside and outside, and the electromotive force generated is large.

● When a lean air-fuel mixture is burnt in the cylinder, oxygen remains in the exhaust gases even after the catalytic action, and this results in a small difference in the oxygen concentration. The electromotive force is very small.

● The difference in oxygen concentration changes greatly in the vicinity of the optimum air-fuel ratio, and hence the change in the electromotive force is also large. By inputting this information into the ECM, the air-fuel ratio of the supplied mixture can be determined easily. The oxygen sensor does not generate much electromotive force when the temperature is low. The characteristics of the electromotive force stabilize at temperature of approximately 300 to 400°C (572 to 752°F).

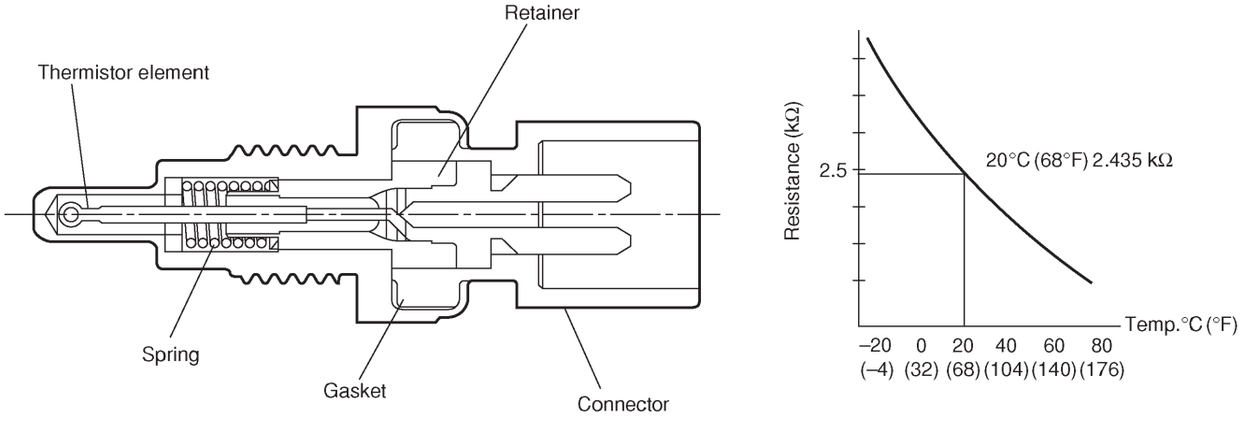




G2H0038

C: ENGINE COOLANT TEMPERATURE SENSOR

● The engine coolant temperature sensor is located on the engine coolant pipe which is made of aluminum alloy. Its thermistor changes resistance with respect to temperature. A engine coolant temperature signal converted into resistance is transmitted to the ECM to control the amount of fuel injection, ignition timing, purge control solenoid valve, etc.



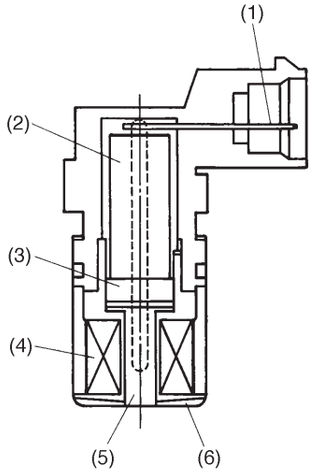
B2H3452A

D: CRANKSHAFT POSITION SENSOR

1. MT VEHICLES

● The crankshaft position sensor is installed on the oil pump, located in the front center portion of the cylinder block, to detect the crankshaft position. It is designed so that the ECM accurately reads the number of pulses which occur when protrusions provided at the perimeter of the crankshaft sprocket (rotating together with the crankshaft) cross the crankshaft position sensor.

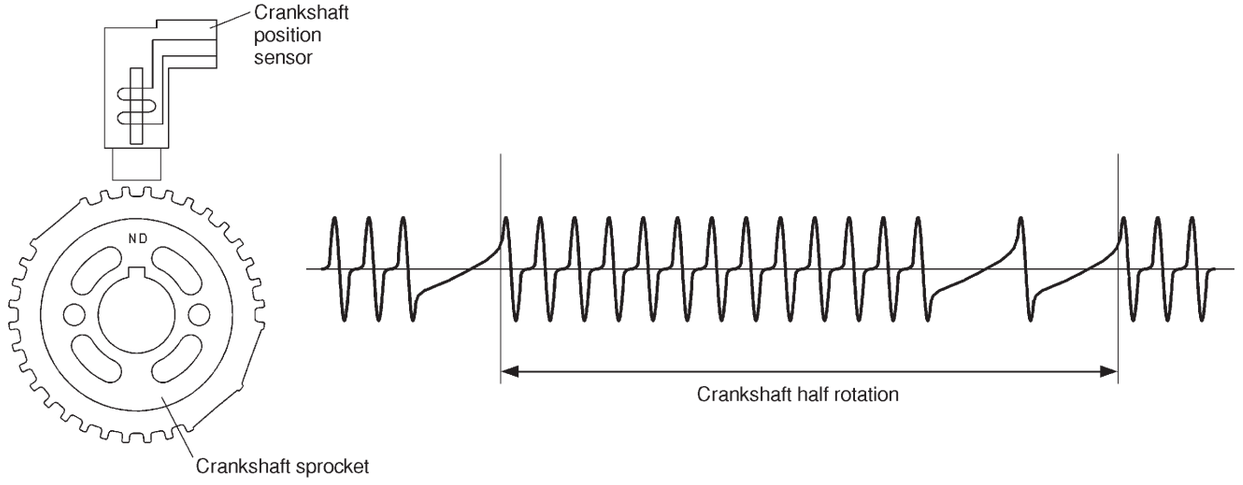
● The crankshaft position sensor is a molded type which consists of a magnet, core, coil, terminals, etc.



B2H0407B

(1) Terminal
(2) Yoke core
(3) Magnet
(4) Coil
(5) Core
(6) Cover

● Crankshaft rotation causes these protrusions to cross the crankshaft position sensor so that magnetic fluxes in the coil change with the change in air gap between the sensor pickup and the sprocket. The change in air gap induces an electromotive force which is transmitted to the ECM.

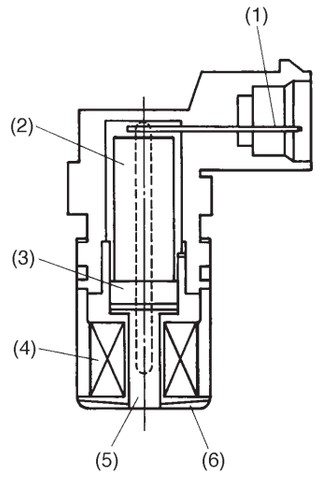


B2H3811A

2. AT VEHICLES

● The crankshaft position sensor is installed on the oil pump, located in the front center portion of the cylinder block, to detect the crankshaft position. It is designed so that the ECM accurately reads the number of pulses which occur when protrusions provided at the perimeter of the crankshaft sprocket (rotating together with the crankshaft) cross the crankshaft position sensor.

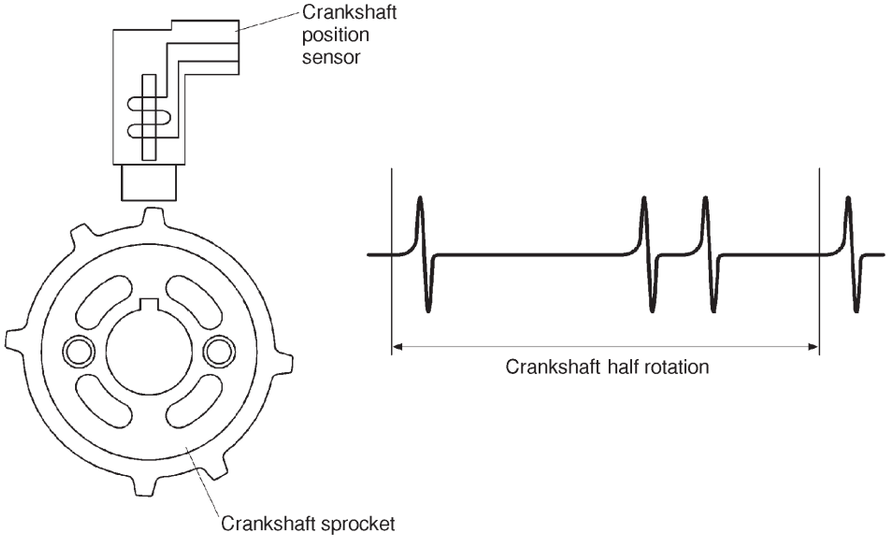
● The crankshaft position sensor is a molded type which consists of a magnet, core, coil, terminals, etc.



B2H0407B

(1) Terminal
(2) Yoke core
(3) Magnet
(4) Coil
(5) Core
(6) Cover

● Crankshaft rotation causes these protrusions to cross the crankshaft position sensor so that magnetic fluxes in the coil change with the change in air gap between the sensor pickup and the sprocket. The change in air gap induces an electromotive force which is transmitted to the ECM.



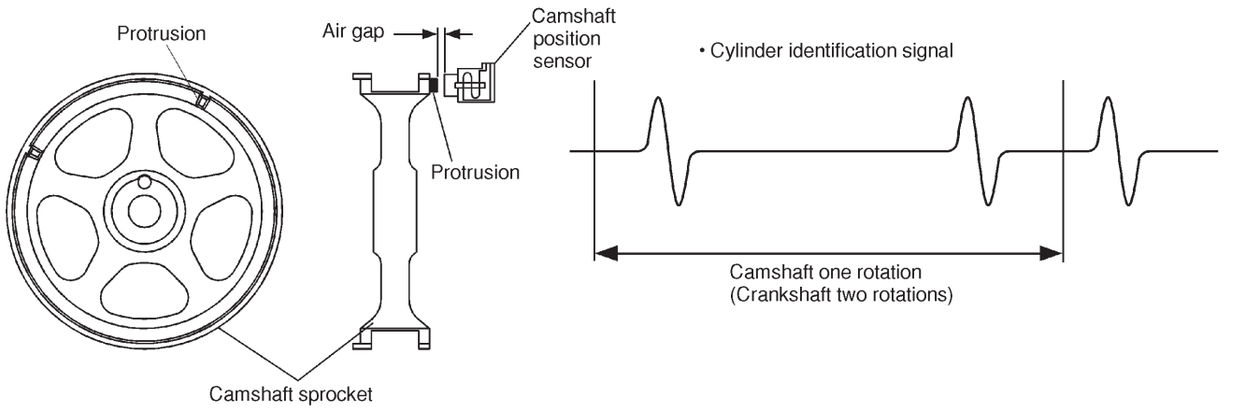
B2H1995A

E: CAMSHAFT POSITION SENSOR

1. MT VEHICLES

● The camshaft position sensor is located on the left-hand camshaft support to detect the combustion cylinder at any one moment.

● It is designed so that the ECM accurately reads the number of pulses which occur when protrusions provided on the back of the left hand camshaft-drive sprocket cross the sensor.
Internal construction and the basic operating principle of the camshaft position sensor are similar to those of the crankshaft position sensor. A total of seven protrusions (one each at two locations, two at one location and three at one location) are arranged in four equal parts of the sprocket, as shown below.

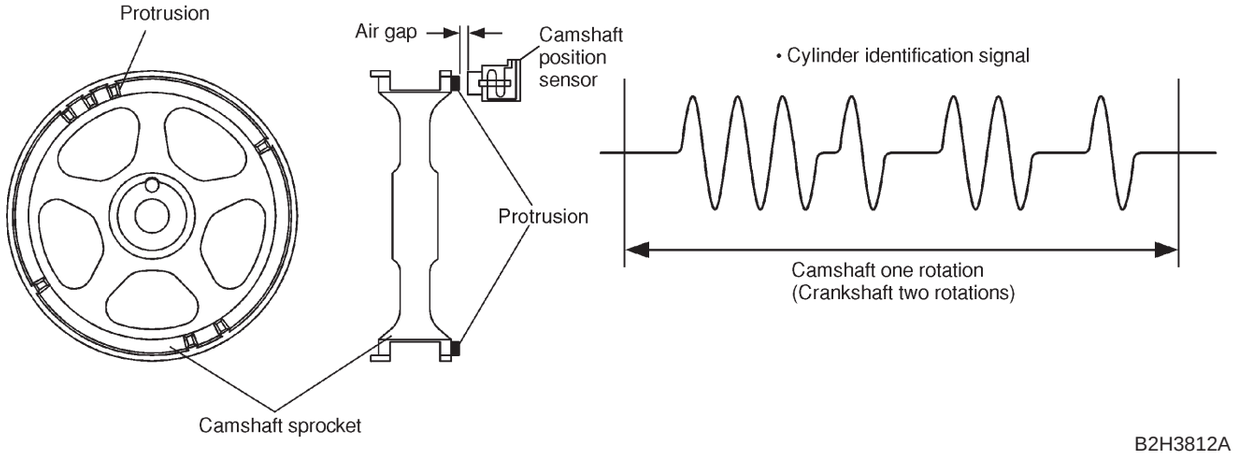


B2H1996A

2. AT VEHICLES

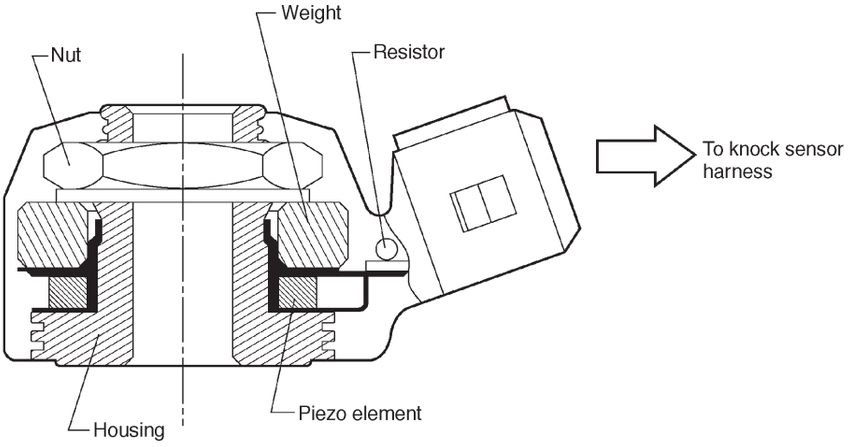
● The camshaft position sensor is located on the left-hand camshaft support to detect the combustion cylinder at any one moment.

● It is designed so that the ECM accurately reads the number of pulses which occur when protrusions provided on the back of the left hand camshaft-drive sprocket cross the sensor.
Internal construction and the basic operating principle of the camshaft position sensor are similar to those of the crankshaft position sensor. A total of seven protrusions (one each at two locations, two at one location and three at one location) are arranged in four equal parts of the sprocket, as shown below.



F: KNOCK SENSOR

- The knock sensor is installed on the cylinder block, and senses knocking signals.
- This knock sensor is a piezo-electric type which converts knocking vibrations into electric signals.
- It consists of a piezo-electric element, weight, and case. If knocking occurs in the engine, the weight in the case moves causing the piezo-electric element to generate a voltage.
- The knock sensor is connected to the bulkhead harness through the knock sensor harness.

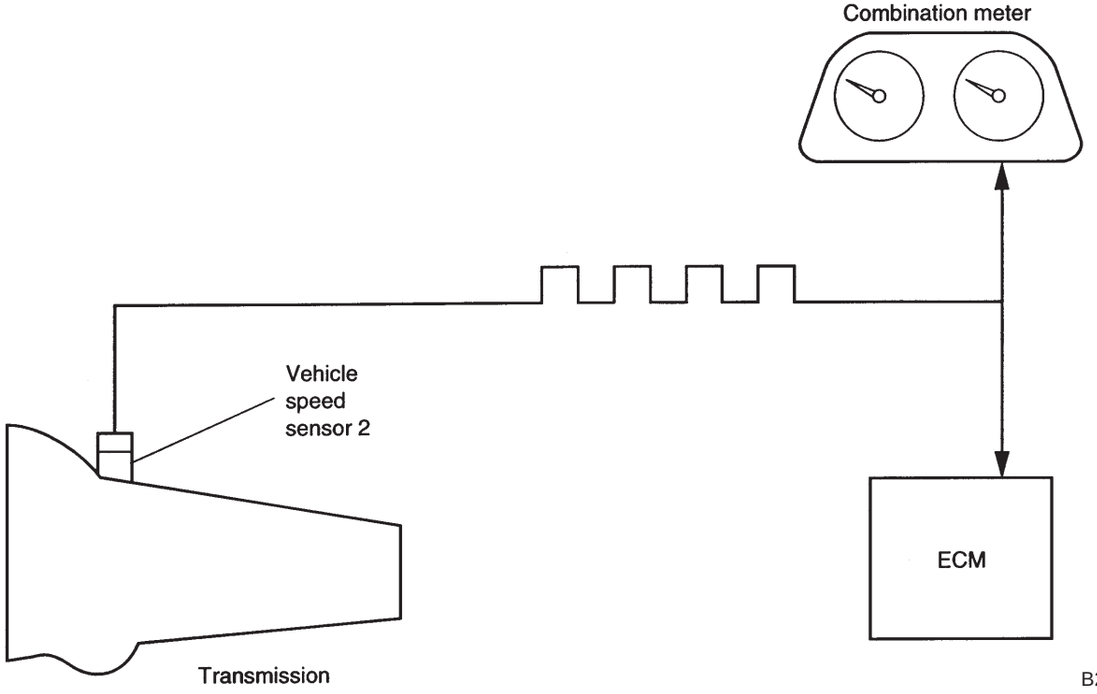


B2H1998A

G: VEHICLE SPEED SENSOR 2

1. MT VEHICLES

- The vehicle speed sensor 2 is a pick-up type output sensor, and mounted on the transmission.
- The vehicle speed sensor 2 generates a 4-pulse signal for every rotation of the front differential and send it to the ECM and the combination meter.



B2H2458A

2. AT VEHICLES

- The vehicle speed sensor 2 is a pick-up type output sensor, and mounted on the transmission.
- The vehicle speed sensor 2 generates a 16-pulse signal for every rotation of the front differential and send it to the TCM. The signal sent to the TCM is converted there in a 4-pulse signal, and then sent to the ECM and the combination meter.