

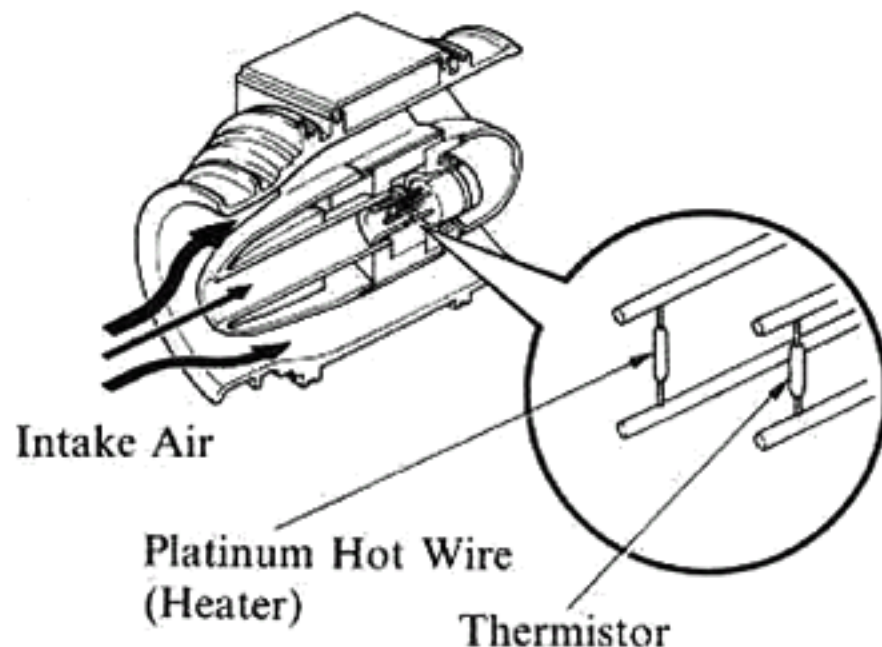
Mass Air Flow Meter

Description

The 2JZ-GTE engine adopts the hot-wire type mass air flow meter designed for direct electrical measurement of the intake air mass flow.

This mass air flow meter offers superior measuring precision and its plastic housing is shaped for minimal flow resistance. In addition to the sensor itself being miniscule, this system measures the bypass air, which is unlikely to be affected by the air cleaner drift current, and has the following features:

- Compact and lightweight, the pressure loss caused by this sensor is small, and offers only slight intake air flow resistance.
- Superior response and measuring accuracy.
- Ability to measure a wide airflow range.
- Having no mechanical functions, it offers a superior durability.



Principle

When the hot wire is placed in a constant gaseous current, the hot wire temperature varies in accordance with the amount of the air mass flow. If the temperature difference between the hot wire and air mass at that time is " ΔT ", air mass flow is " G ", and the dissipated heat is " Q ", the relationship between them can be described with the following formula:

$$Q = (a + b\sqrt{G}) \cdot \Delta T \text{ ("a" and "b" are constants)}$$

Furthermore, this heat value can be electrically represented. If the hot wire resistance is " R ", electrical current flowing through the hot wire is " I ", the heat value " Q " can be described with the following formula:

$$Q = I^2 R$$

Accordingly, the two formulas above can be described as follows:

$$I^2 R = (a + b\sqrt{G}) \cdot \Delta T$$

If current " I " is flowed in order to make the temperature difference " ΔT " consistent, since " R ", " a ", " b ", and " ΔT " are all constant, a proportional relationship is created between the air mass flow " G " and the current " I ", enabling the air mass flow " G " to be represented by the current " I ". By converting this current " I " into voltage, the hot-wire type mass air flow meter outputs the air mass flow signals to the ECM [engine ECU].

Construction and Operation

To keep the temperature of the platinum hot wire constant with the sum of the intake air temperature measured by the thermistor and the predetermined temperature difference (ΔT), this hot-wire type mass air flow meter has an electric bridge circuit which includes the hot wire and other resistances. Combined with an operational amplifier and power transistor, the feedback loop, as described below, is achieved.

In this circuit, when the electrical potential at points "A" and "B" becomes equal, the resistors are selected to make the temperature difference between the hot wire and air mass constant. When the hot wire is cooled by the intake air, its resistance value decreases. As a result, the voltage at point "B" becomes higher than that of the point "A". At this time, the operational amplifier detects this electrical potential difference, and controls the power transistor so that the electrical potentials of the points "A" and "B" becomes equal, and flows the current to the circuit.

This mass air flow meter outputs the voltage at point "B", immediately following the hot wire. The ECM uses this voltage (VG signal) to determine the intake air mass flow according to the aforementioned principle.

The VG signal, which varies in accordance with the intake air mass flow, is continuously output from the mass air flow meter. The relationship between the output voltage of the VG signal and the intake air mass flow can be represented as a parabolic curve shown below.

