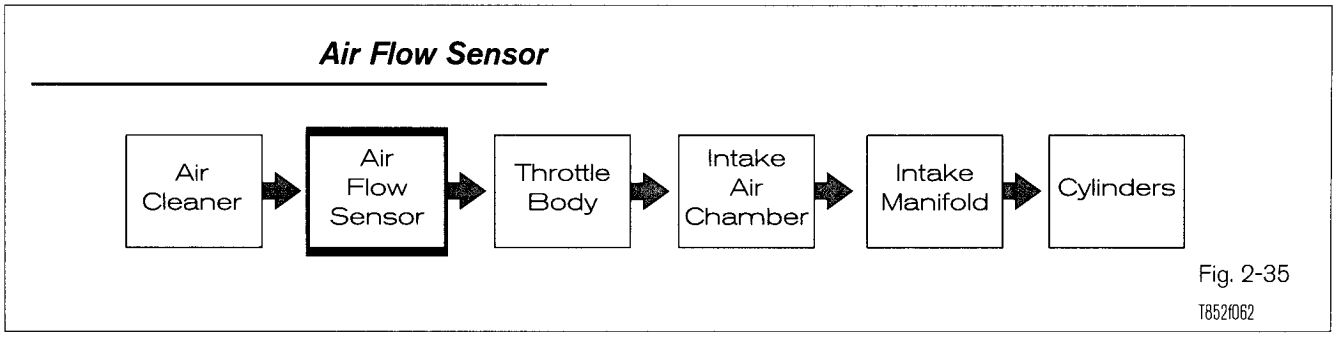
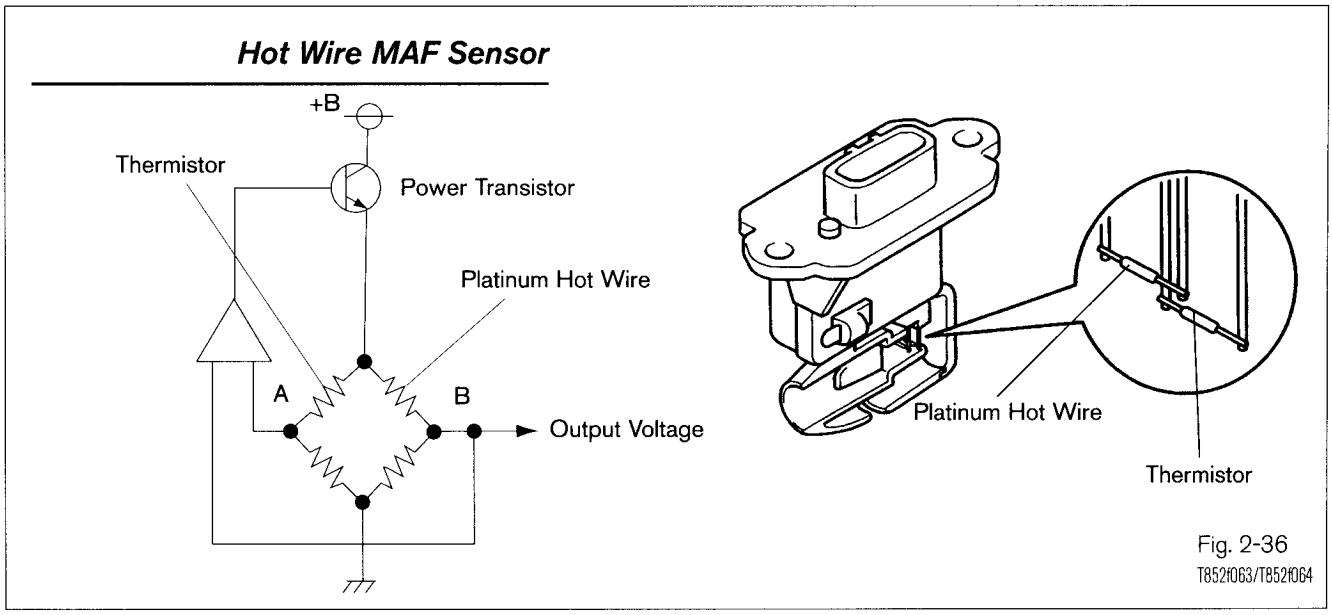


Mass Air Flow (MAF) Sensors

The Mass Air Flow Sensors converts the amount of air drawn into the engine into a voltage signal. The ECM needs to know intake air volume to calculate engine load. This is necessary to determine how much fuel to inject, when to ignite the cylinder, and when to shift the transmission. The air flow sensor is located directly in the intake air stream, between the air cleaner and throttle body where it can measure incoming air.

There are different types of Mass Air Flow sensors. The vane air flow meter and Karmen vortex are two older styles of air flow sensors and they can be identified by their shape. The newer, and more common is the Mass Air Flow (MAF) sensor.

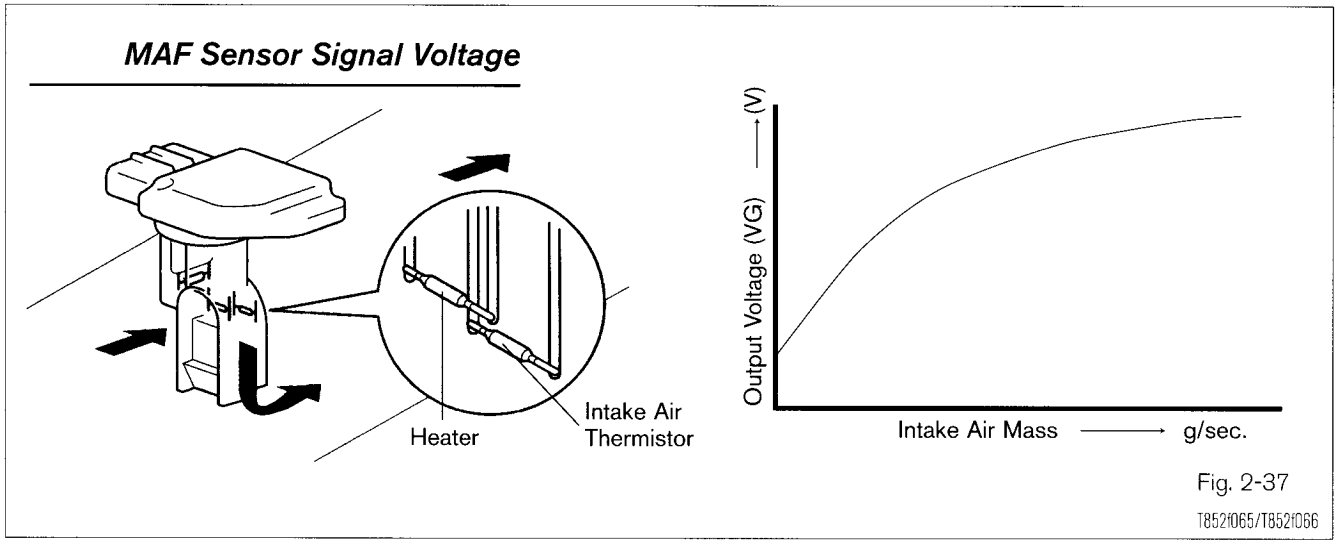


Mass Air Flow Sensor: Hot Wire Type

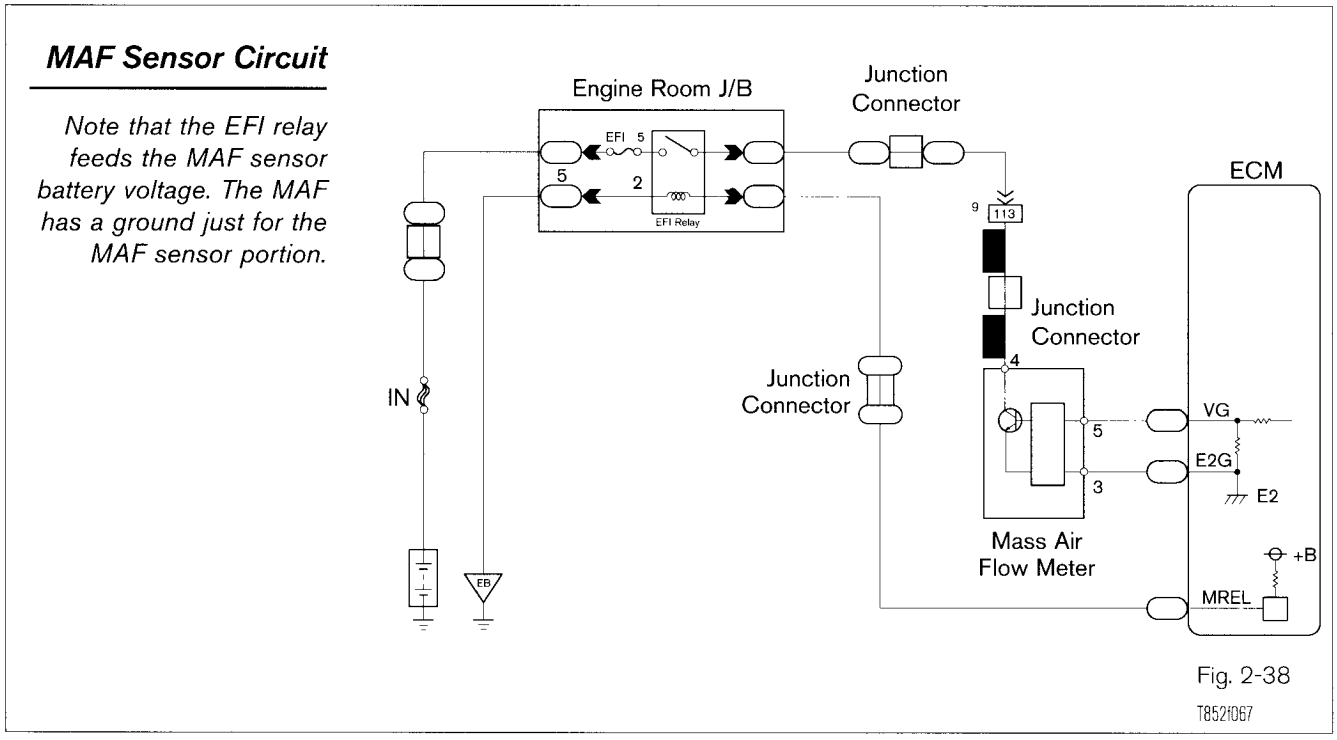
The primary components of the MAF sensor are a thermistor, a platinum hot wire, and an electronic control circuit.

The thermistor measures the temperature of the incoming air. The hot wire is maintained at a constant temperature in relation to the thermistor by the electronic control circuit. An increase in

air flow will cause the hot wire to lose heat faster and the electronic control circuitry will compensate by sending more current through the wire. The electronic control circuit simultaneously measures the current flow and puts out a voltage signal (VG) in proportion to current flow.



This type of MAF sensor also has an Intake Air Temperature (IAT) sensor as part of the housing assembly. Its operation is described in the IAT section of Temperature Sensors. When looking at the EWD, there is a ground for the MAF sensor and a ground (E2) for the IAT sensor.



Diagnosis

Diagnosis of the MAF sensor involves visual, circuit, and component checks. The MAF sensor passage must be free of debris to operate properly. If the passage is plugged, the engine will usually start, but run poorly or stall and may not set a DTC.

MAF Supply Voltage

The +B terminal supplies voltage for the MAF Sensor. VG is the MAF signal line and E2G is the ground. THA terminal supplies 5 Volts for the IAT sensor and E2 is the ground.

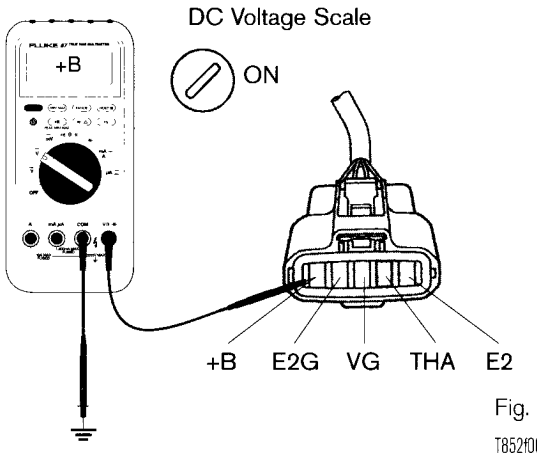


Fig. 2-39
T8521068

MAF Ground Circuit

MAF ground circuit check is performed with an ohmmeter.

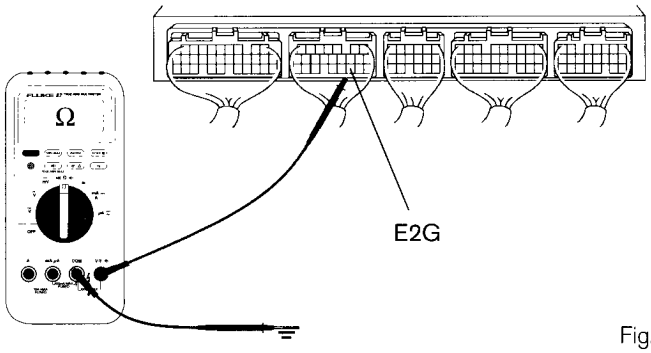


Fig. 2-40
T8521069

Checking MAF Operation

Most MAF sensors can be checked by supplying power and a ground to the right terminals, connecting a voltmeter to the signal (VG) wire, and blowing air through the sensor.

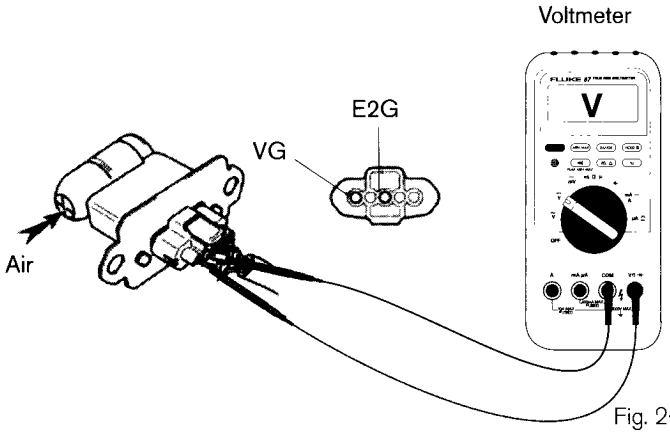


Fig. 2-41
T8521070

Vane Air Flow Meter

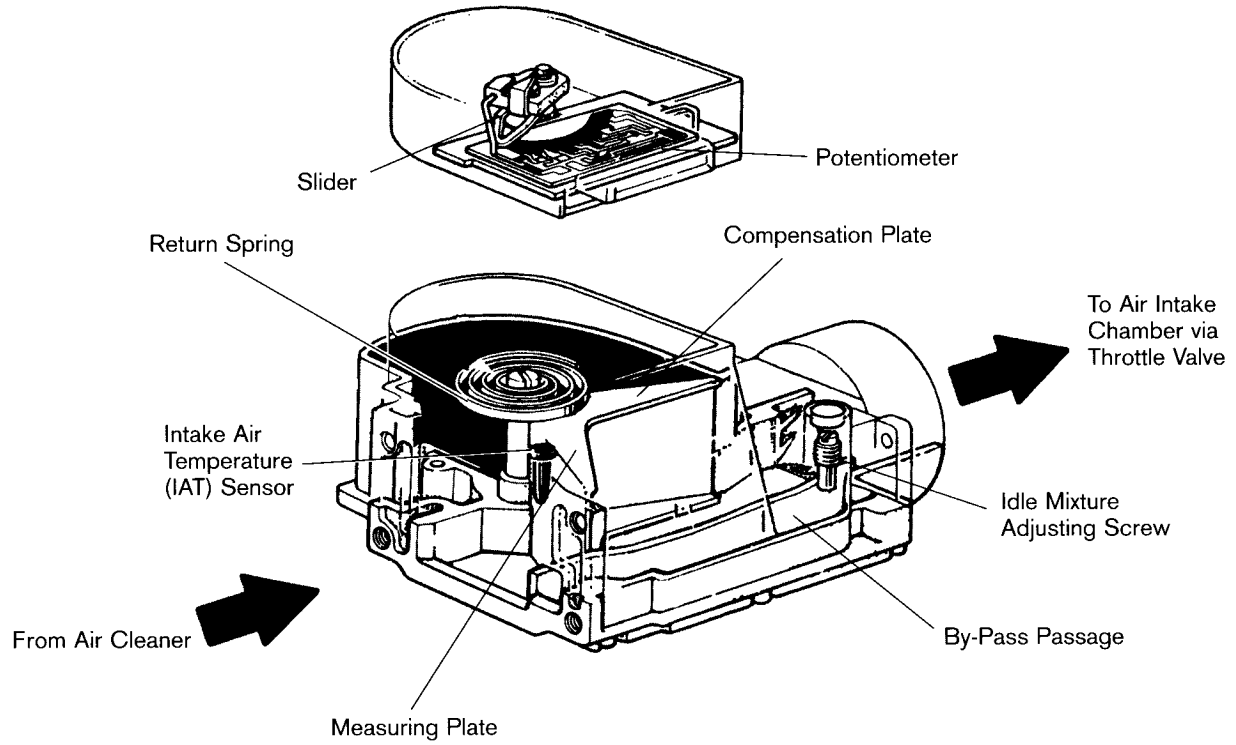


Fig. 2-42
T852f071

Vane Air Flow Meter

The Vane Air Flow Meter provides the ECM with an accurate measure of the load placed on the engine. The ECM uses it to calculate basic injection duration and basic ignition advance angle. Vane Air Flow Meters consist of the following components:

- Measuring Plate.
- Compensation Plate.
- Return Spring.
- Potentiometer.
- Bypass Air Passage.
- Idle Adjusting Screw (factory adjusted).
- Fuel Pump Switch.
- Intake Air Temperature (IAT) Sensor.

VAF Meter Operation

The measuring plate is deflected in proportion to the volume of intake air flow. The damping chamber helps reduce rapid movement of the measuring plate.

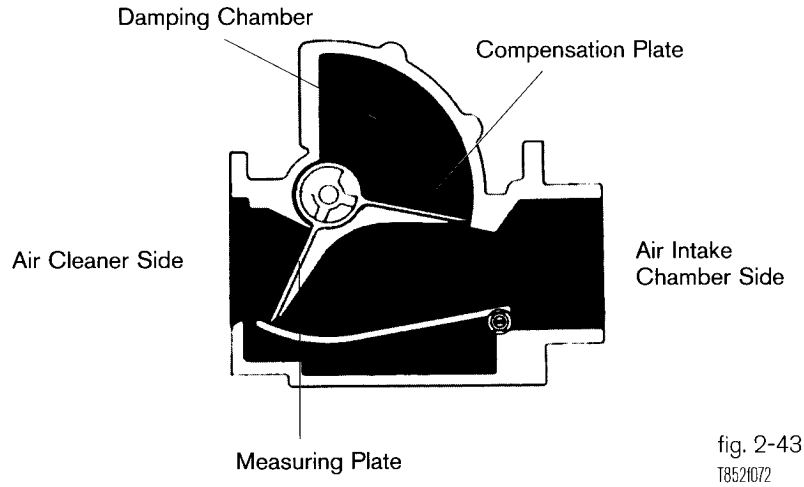


fig. 2-43
T852f072

During engine operation, intake air flow reacts against the measuring plate (and return spring) and deflects the plate in proportion to the volume of air flow passing the plate. A compensation plate (which is attached to the measuring plate) is located inside a damping chamber and acts as a "shock absorber" to prevent rapid movement or vibration of the measuring plate.

Movement of the measuring plate is transferred through a shaft to a slider (movable arm) on the potentiometer. Movement of the slider against the potentiometer resistor causes a variable voltage signal back to the VS terminal at the ECM. Because of the relationship of the measuring plate and potentiometer, changes in the VS signal will be proportional to the air intake volume.

VAF Meter Circuit

The potentiometer inside the VAF provides a variable voltage signal to the ECM. This is the second design, the newer type.

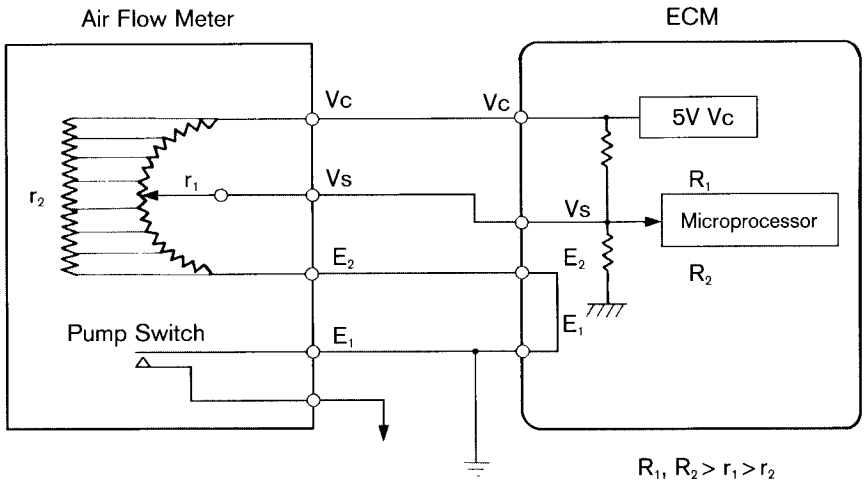


fig. 2-44
T852f073

The r2 resistor (connected in parallel with r1) allows the meter to continue to provide a VS signal in the event that an open occurs in the main potentiometer (r1). The Vane Air Flow Meter also has a fuel pump switch built into the meter that closes to maintain fuel pump operation once the engine has started and air flow has begun.

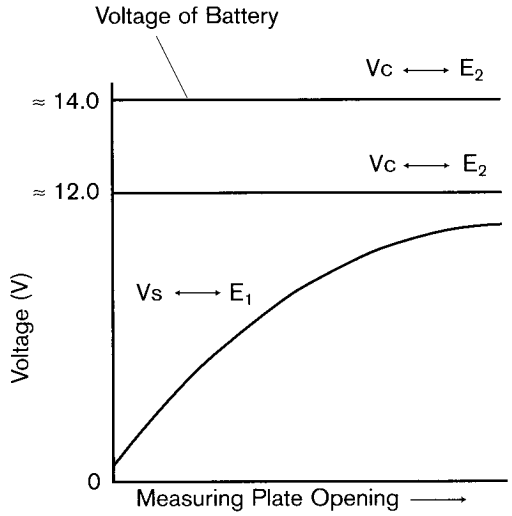
The meter also contains a factory adjusted idle adjusting screw that is covered by a tamper - resistant plug. The repair manual does not provide procedures on resetting this screw in cases where it has been tampered with.

Types of VAF Meters

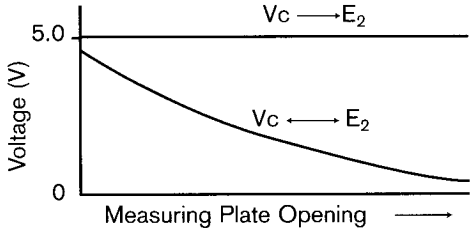
There were two major types of VAF meters. The first design, is the oldest type. It uses battery voltage for supply voltage. With this type of VAF meter, as the measuring plate opens signal voltage increases.

VAF Signal Voltage

Two were two different VAF designs. The newest type, second design, the voltage decreases as the measuring plate opens.



First Design



Second Design

Fig. 2-45
T8521074/T8521075

Karmen Vortex Air Flow Meter

Uses a moveable mirror and phototransistor to measure intake air flow. This type of meter operates without restricting air flow.

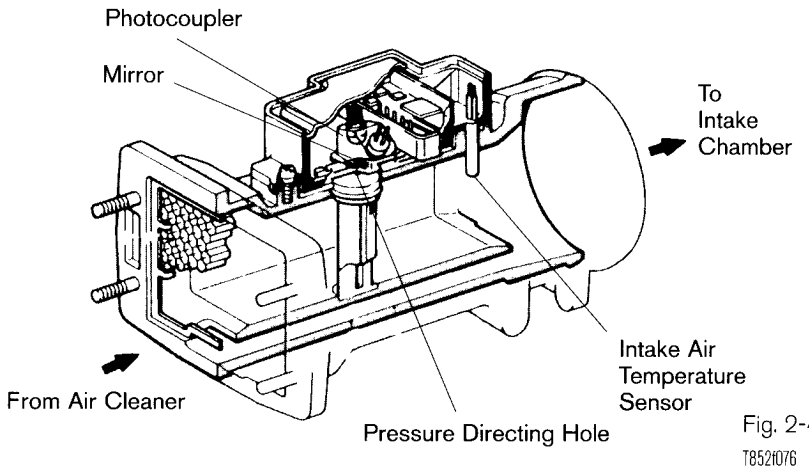


Fig. 2-46
T852f076

Karmen Vortex Air Flow Meter

This air flow meter provides the same type of information (intake air volume) as the Vane Air Flow Meter. It consists of the following components:

- Vortex Generator.
- Mirror (metal foil).
- Photo Coupler (LED and photo transistor).

Karman Vortex Air Flow Meter Operation

Intake air flow reacting against the vortex generator creates a swirling effect to the air downstream, very similar to the wake created in the water after a boat passes. This wake or flutter is referred to as a "Karman Vortex." The frequencies of the vortices vary in proportion to the intake air velocity (engine load).

Karmen Vortex Operation

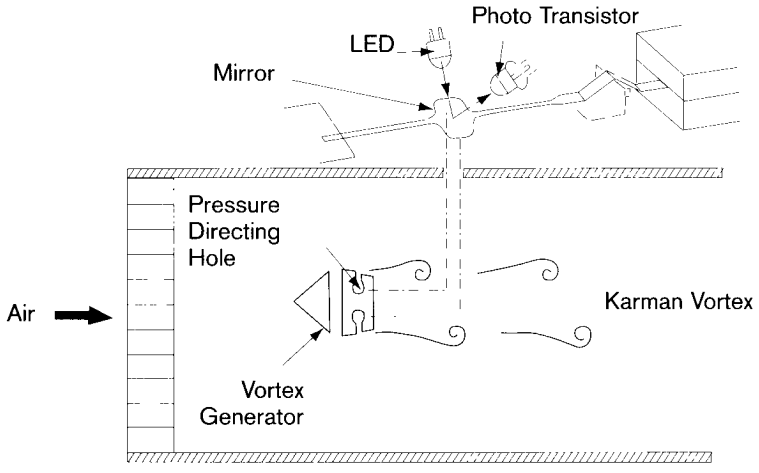
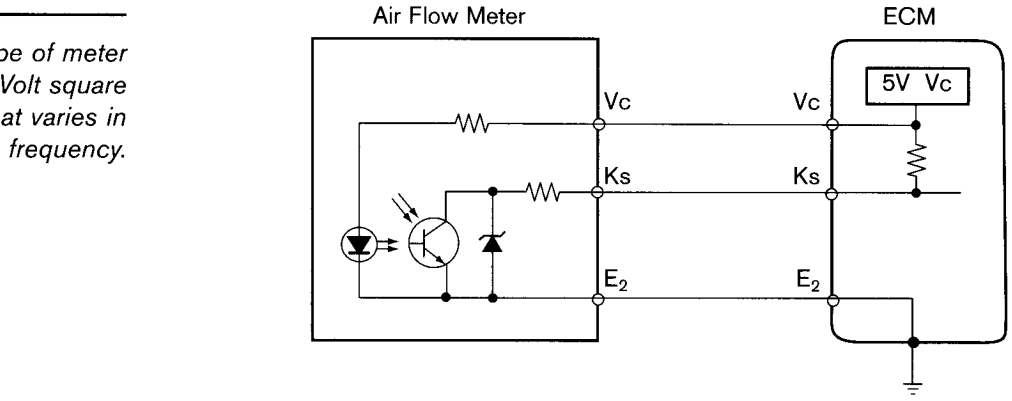


Fig. 2-47
T852f077

The vortices are metered into a pressure directing hole from which they act upon the metal foil mirror. The air flow against the mirror causes it to oscillate in proportion to the vortex frequency. This causes the illumination from the photo coupler's LED to be alternately applied to and diverted away from a photo transistor. As a result, the photo transistor alternately grounds or opens the 5-volt KS signal to the ECM.

Karmen Vortex Air Flow Meter Circuit

This type of meter generates a 5 Volt square wave signal that varies in frequency.



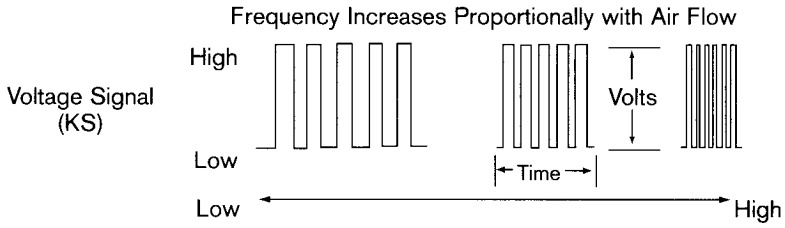


Fig. 2-48

T852f078

This creates a 5 volt square wave signal that increases frequency in proportion to the increase in intake air flow. Because of the rapid, high frequency nature of this signal, accurate signal inspection at various engine operating ranges requires using a high quality digital multimeter (with frequency capabilities) or oscilloscope.

ASSIGNMENT **NAME:** _____

1. Explain the purpose of a Mass Air Flow sensor?

2. List the different types of Mass Air Flow Sensors?

3. Explain in detail the constructions and how a MAF (hot wire type) works?

4. What type of voltage signal is produced by a MAF and what would you expect to change as RPM is increased?

5. Explain in detail the testing procedure of a MAF sensor.

6. Explain in detail the constructions and how a VAF (Vane Air Flow Meter) works?

7. What type of voltage signal is produced by a VAF and what would you expect to change as RPM is increased?

8. Explain in detail the constructions and how a Karmen Vortex works?

9. What type of voltage signal is produced by a Karmen Vortex and what would you expect to change as RPM is increased?

