



Tired of Living In Vane?

A MASS AIR FLOW SENSOR MAY BE THE TICKET **BY MARK AMARANDOS**

[Being more comfortable with Webers and Multi-Synch vacuum gauges than the new-fangled stuff, we can't swear to the following claims of increased torque and horsepower. But the logic seems reasonable, so you may want to investigate further.—SC]

A significant performance enhancement can be realized in older BMWs by converting the air flow meter (AFM) to a mass air flow (MAF) sensor. Because the two types of sensors are so different, a signal conditioning unit is required to complete the conversion. In addition to increased horsepower and torque, the conversion results in improved throttle response and smooth power delivery throughout the entire RPM range.

Many of the 3, 5, 6, and 7 Series cars produced in the 1980s and early 1990s can benefit from this conversion. It makes a big difference on the E30 M3 and E28 M5. This conversion will be of particular interest to club racers and performance enthusiasts; in addition to the initial performance gain, the MAF conversion provides a convenient way to dial-in the proper air/fuel ratio on modified engines.

AFM VS. MAF SENSORS

Modern fuel injection systems tightly control air/fuel ratio for proper combustion by measuring the amount of air entering the

engine. This information is used by the engine computer to precisely adjust the amount of fuel that is injected into the engine.

Earlier fuel injection systems used an airflow meter, which is also called a vane meter because it measures the amount of air entering the engine by monitoring the displacement of a spring loaded flapper door, or vane, in the air stream. Airflow meters are slow to respond, very restrictive, and induce severe turbulence in the air stream. They rob horsepower and degrade throttle response.

Current BMW fuel injection systems use mass air flow sensors. MAF sensors are also known as hot wire or hot film sensors; they measure the mass of air entering the engine by measuring the cooling effect that the passing air has on a heated wire or film. MAF sensors are used on all new BMWs; they have no moving parts to fail, respond very quickly, and are far less restrictive than air flow meters.

GETTING A MAF SENSOR TO WORK ON AN ENGINE DESIGNED TO USE AN AFM

Conversion from an AFM to a MAF sensor is complicated by many factors. The AFM measures flow, while the MAF measures the *mass* of air flow. As such, the MAF sensor output is affected by temper-

ature, barometric pressure, and elevation. The MAF also responds much more quickly than an AFM, which can cause false readings and stability problems.

For these reasons, the AFM cannot simply be replaced by the MAF sensor. A signal conditioning unit is required to complete the conversion. The Split Second ARC2 was designed specifically for this purpose; it does everything needed to make the MAF sensor output look like an AFM signal. In addition, it provides the necessary adjustments to calibrate the MAF sensor signal. These adjustments can be used to establish proper air/fuel ratio in modified engines such as those with turbochargers, or different fuel pressure regulators or injectors.

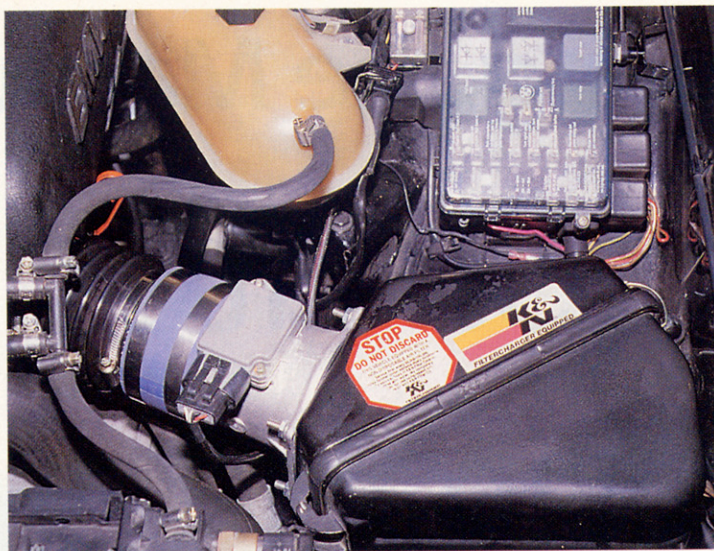
PUTTING IT ALL TOGETHER

Consider the AFM to MAF conversion installed on a 1988 M5. The MAF sensor is a 73mm Ford unit; however, a Bosch unit could also have been used. The output of the MAF sensor is connected to the ARC2 calibrator. The output of the ARC2 connects to the engine computer through the connector that normally goes to the AFM.

A Split Second ARM1 air/fuel ratio meter is installed so that the ARC2 can be properly adjusted; the ARM1 reads the stock oxygen sensor, providing immediate feedback about

the operating fuel mixture; in normal operation, the engine computer continuously adjusts the air/fuel ratio around the ideal operating point. This provides optimum combustion for good performance and fuel economy. This continuous adjustment process can be seen on the air/fuel ratio meter as a back and forth sweeping output which is called dithering. An analogy would be the way a home thermostat controls the temperature in your home: The temperature cycles up and down around the ideal set point.

In order to calibrate the ARC2, the controls are adjusted until normal dithering is observed on the ARM1. This indicates that the engine computer is operating in closed-loop mode and properly controlling the fuel mixture. The low, mid, and high settings on the ARC2 are adjusted for proper air/fuel ratio over the entire engine operating range. The accel adjustment on the ARC2 is also set for proper throttle response off idle.



The MAF sensor conversion looks perfectly stock in a 1988 M5 engine compartment. Left: The knobs of the box to the left (the ARC2) are dialed while the LED readouts above the steering column (the ARM1) show how things are burning.

PERFORMANCE IMPROVEMENT

The AFM and MAF sensors can be easily exchanged once the ARC2 and ARM1 installation is complete. This makes it easy to do direct comparisons on a chassis dynamometer. The crankshaft horsepower and torque gains due to changing the

sensors—all else being equal—are 18 horsepower and 18 ft-lbs. of torque. These figures translate into immediately noticeable driving improvement. Not only is there more power, but delivery of that power is immediate and smooth.

While the performance improvement of the AFM to MAF conversion by itself is impressive, it also increases the effectiveness of other engine modifications. Much emphasis has been placed on free-flow exhaust, larger throttle bodies, and less restrictive air boxes. The maximum benefit of these changes will be realized by eliminating the restriction caused by the air flow meter.

Many performance upgrades require a compromise in comfort or convenience, but this upgrade is long on benefits and short on drawbacks. The engine is more responsive and strong, yet maintains good fuel economy and low emissions. It should be noted that the ARC2 is sold for off-road use only. More information is available from Split Second at www.splitsec.com. ●



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