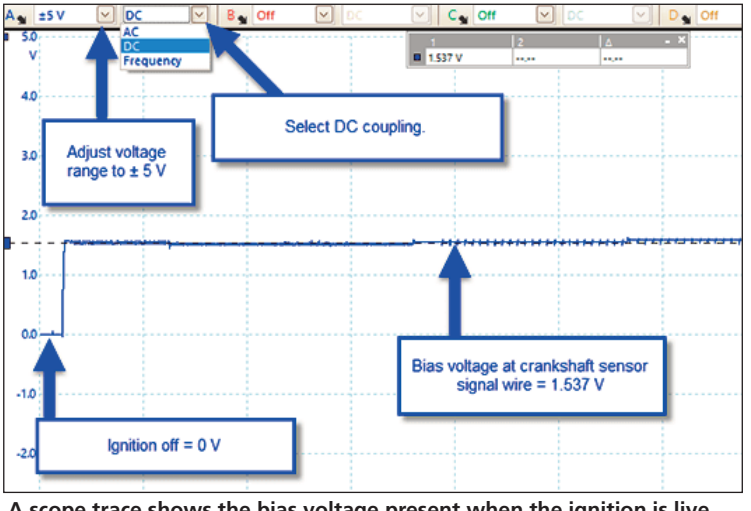
Understanding Bias Voltage Diagnostics for Sensors

In modern vehicle electronic systems, the vast amount of sensors and actuators are vital to the correct and efficient performance of the system, as designed by the manufacturer.

Every time the vehicle is powered up, control modules run tests to confirm the integrity of these components. This is where bias signals play a vital part of these power on self-test processes. It is how a control module can determine if a component is correctly in circuit, or displaying short or open circuit characteristics, and then generate the relevant trouble code and setting a default value if possible, for the suspect sensor or actuator. This is performed by the controller, by sending a small voltage through the component and monitor the returned signal. The returned signal is compared to a known good return signal.

In diagnosing a system error, the use of these bias voltages can save the technician time and lead to a more accurate diagnosis. That makes understanding where and how to use these signals vital.

Two recent cases came to the Helpline that indicated the exact principle of these processes.



A scope trace shows the bias voltage present when the ignition is live and the sensor's signal will be added to this baseline

Citroen Fuel Regulator Fault

A Citroen Relay, with a fault code for fuel regulator control short to ground, was causing diagnosing problems for a garage. The power supply was tested and voltage was present. The mechanic monitored the control side and it was showing a ground without any of the control activity he expected.

We asked him to check the voltage on the loom with the actuator disconnected, and he found a small voltage present until it was reconnected. This proved that the circuit integrity to the volume valve was good and the short was internally in the valve itself.

Lambda Sensor Faults

A common bias voltage that is easy to prove is for lambda sensor faults. On the signal wire in a 4-wire zirconia lambda sensor, there is a 450 mv bias voltage. When the sensor is at operating temperature, the output from these sensors can pull down and up the signal according to the mixture. Monitoring this bias on serial data on a cold sensor will give vital diagnostic information.

Tim Stock

Recently, a garage had a vehicle with a fault code for rear lambda sensor rich condition and it was showing 1030mv, when the sensor was cold. The voltage did not alter when at operating temperature. We asked for the technician to monitor this voltage and disconnect the rear lambda sensor. As soon as it was disconnected, the bias returned to 450mv, proving the high voltage was coming from a short circuit within the rear sensor heater.

Faulty Crankshaft Signal?

A recent call from a technician with a question on a crankshaft signal that he thought was faulty. He was new to using a Picoscope, and while sampling a crankshaft signal from an inductive sensor, he noticed the signal was not returning to zero, but was sitting at 2.5 volts above the zero line.

We explained about bias voltages, and how it was common for an inductive sensor to have a DC offset or bias voltage and the signal will ride on top of this. The bias voltage is used by the PCM to diagnose circuit faults, and is completely normal.