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<u>CURRENT AFFAIRS PMM DECEMBER TROUBLESHOOTER</u>

There have been several key moments in the last 18 years of vehicle diagnostics, leading to significant changes in our methods and procedures.

One of the most memorable for us was the introduction of current measurement in pulsed circuits. It came about due to unacceptable inaccuracies in PCM testing through a modem we where using at the time.

PCM simulation failed to identify some errors in actuator and coil drive circuits leading to an unnecessary increase in the diagnostic time to complete satisfactory repairs.

Like all changes in procedure there is a learning curve and a period of research and development to ensure accuracy and success.

The first step was to obtain the correct tools. We were already using a high specification digital storage oscilloscope, so obtaining a suitable high frequency inductive current clamp (DC to 100 kHz 0-30A) was simply a matter of contacting several electronics suppliers for choice and price.

We then began evaluating both voltage profile and current flow through inductor and actuator circuits. If you apply the time honoured equation current = voltage ÷ resistance it should all become so predictably simple! If only.

For example a coil with 0.5Ω impedance and voltage supply of say 15V should provide a current flow of 30 Amps.why then is the average current flow of an ignition coil circuit between 7amp-10 amps.

The answer is not quite so simple as the equation suggests.

Current flow through an inductor circuit will rise exponentially against time acting against it is the build up of electromagnetic field strength.

Peak current limiting circuits within the power stage will ensure the correct and appropriate saturation time control ,and prompt current interruption.

More complex pulse width modulation control replaces peak and hold and ballasted circuits. The only way to correctly evaluate current flow through circuits is in situ plotting the current path against voltage.

The following procedures will serve to conclude last month's topic on ignition evaluation and introduce accurate assessment of injector circuits.

Waveform (1) represents the normal voltage and current transition in a sample ignition system, note the way current build up appears linear against saturation time up to the moment of peak current control. At the point of induction, current is interrupted promptly causing a rapid increase in voltage, and a corresponding sudden reduction in current. Some undershoot i.e. Negative current flow is normal, this causes a reciprocal rise in voltage resulting in the phenomenon of coil ringing or oscillation at the end of the inductive cycle. The natural tendency of coils is to dissipate in a sinoidal manner.

Waveform 2) however shares all the correct voltage and current patterns except the interruption is not sudden resulting in some leakage prior to complete collapse, the result of which is a shorter burn time and lower ignition energy

Peak current and saturation time are normal the fault is of course a power stage error.

Waveform 3) demonstrates an unnatural increase in current rise, normal peak current flow and interruption confirms correct power stage control, the cause is a partial short circuit within the inductor primary circuit.

Waveform 4) demonstrates abnormal current rise, correct peak current and severe leakage at the point of induction Current collapse was casual rather than sudden, the cause, power stage error.

The advantage of current measurement over voltage profile evaluation is that measurement can be taken remotely from the component in either the power or ground circuit. This excludes the need for power supply and ground reference checks. It is also more representative of how the current is passing through the circuit

Prior to this current flow was predicted by looking at the peak voltage induction and the slew rate profile, viewed in detail at the base of the saturation period.

Waveform 5) we also noted carefully the earth reference during the saturation period. You have no doubt noted the similar way in which the events mimic each other. The peak ground reference should not exceed 200 mV.

The slew rate is a little more difficult to predict without prior specific knowledge; its profile is determined by voltage supply, ground reference, inductance and current flow it can also be effected by the lifting of the pinnate in an injector, this often results in a significant stepped rise in the slew rate.

I hope you now appreciate that little equation isn't as simple as it looks on paper, but then diagnostics never is.