TomcoTechtips
TM

ISSUE 38

Injectors

In the past we have looked at the internal styles of the injectors. Now lets take a look at the electronics. There are two main styles of injectors. One style is called "saturated" the other one is called "peak and hold." These styles are not only dependent on the electronics of the injector, but of the computer circuitry as well.

Saturated injectors typically have between 12 and 16 ohms of resistance in their coil windings. They get their name from the fact that the injector coils become fully saturated by the driver in the Powertrain Control Module (PCM). If we have an injector that is 12 ohms and we apply 12 volts to it, we can calculate the current flow.

Remember that Ohms Law states:

I(Current) = V(Voltage) ÷ R(Resistance).

In this case it would be:

I = 12(volts) ÷ 12(ohms), or

I= 1 amp

This is a low current draw and it allows the injector to stay cool and be very durable. The drawback to this is that the injector does not open or close quickly, in relative terms.

The majority of the injectors you would come across would probably be saturated injectors.

Peak and hold injectors typically have between 1 to 3 ohms of resistance in their coil windings. They get their name from the way current is flowed in the injector by the driver in the PCM. Lets go back to Ohms Law. If the injector is 2 ohms and we apply 12 volts to the injector, our formula looks like this:

I = 12(volts) ÷ 2(ohms), or

I=6apms

This would be quite a lot of current for an injector winding to handle for long periods of time.

As soon as the injector reaches peak current, as determined by the PCM driver and injector resistance, the driver switches to a hold state. This state reduces the current flow in the injector to 1 amp (the amount of holding current is dependent on the driver configuration of the particular application). So we have an injector that is opened with a large amount of current. This opens the injector quickly. Since it takes less current to hold something open, after it has been opened, the current is then reduced. This lower current will reduce the heat build up. It also allows for a quicker closing time, because the lower current has resulted in a weaker magnetic field to overcome when closing. The benefits then are a quicker opening and closing time.

Peak and hold injectors are typically used on TBI models and have found their way into some PFI models.

Now lets take a closer look at the drivers inside the PCM. A special thanks to Don Klarer from Automotive Electronics for putting together this section on typical driver configurations.

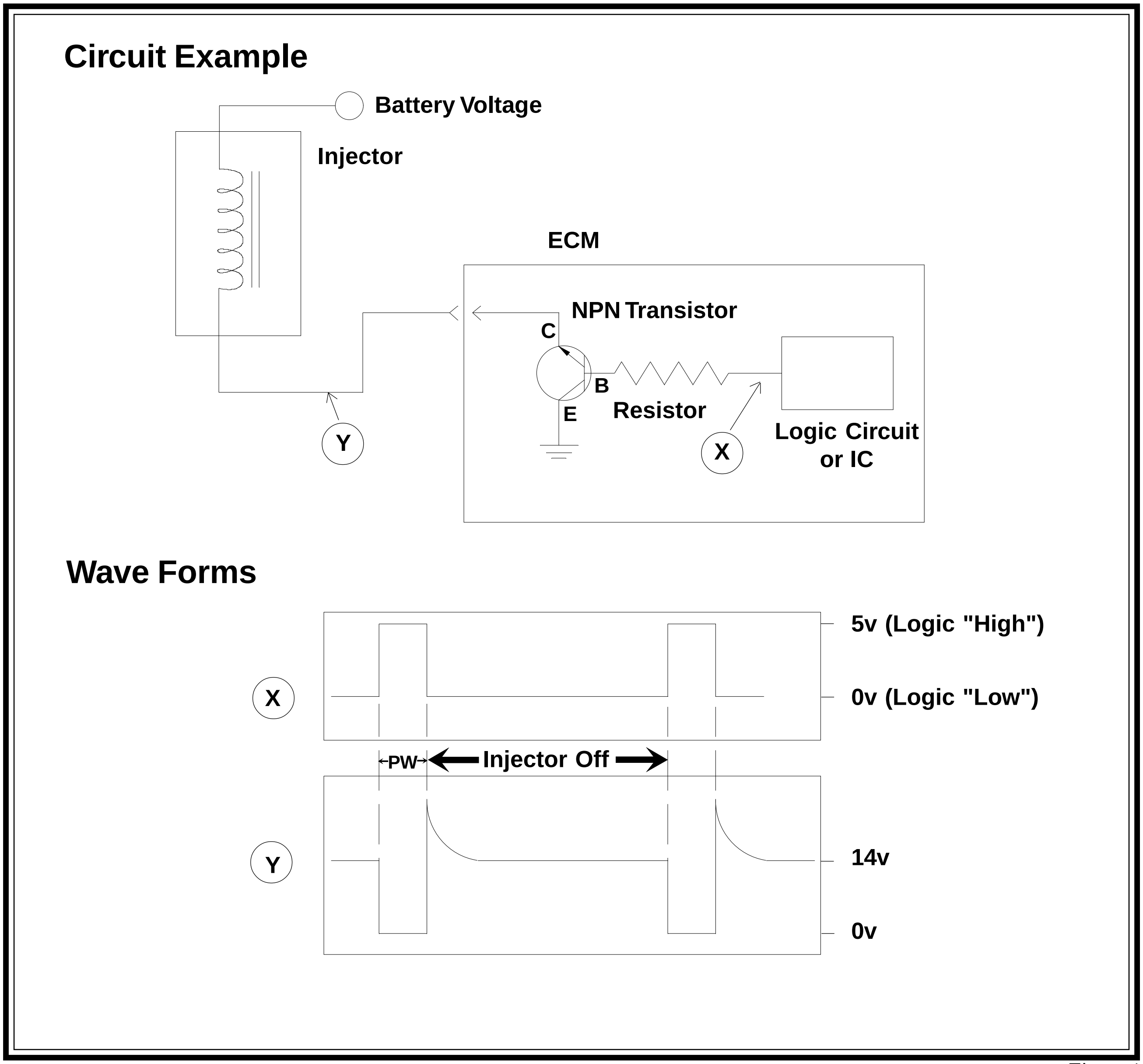

Figure 1

Simple Injector Drive

Figure 1 shows one of the more common configurations. There are variations of the circuit. The ECM's microprocessor calculates the necessary injector pulse width (PW) based on sensor inputs, then outputs a 'High' signal (signal X) to the injector drive transistor through a resistor. (The resistor limits current from the logic components to prevent chip damage in the case of other failed components, i.e. injector or transistor). When the 'High' signal is present on the base (B) of the transistor, it becomes fully saturated, so the collector (C) shorts to the emitter (E). This drives the collector voltage (signal Y) to near 0v so that full battery voltage is dropped across the injector coil to open the pintle. At the end of the pulse duration, the logic circuit goes to a 'low' state (0v), which opens the collector.

The injector slams shut and the resulting collapse in the magnetic field generates a negative current through the windings which is seen as a voltage spike at the end of the pulse duration.

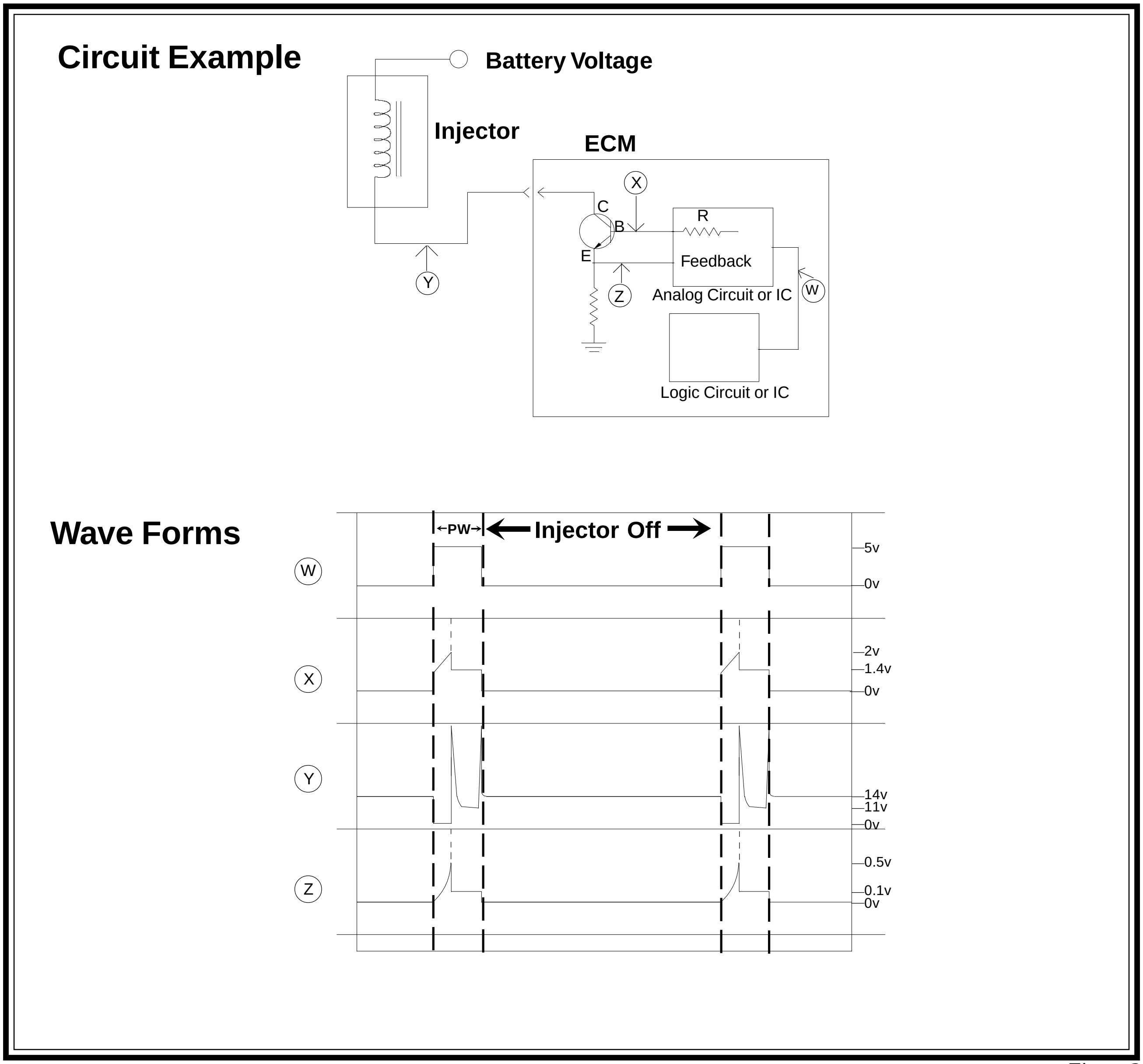

Figure 2

Peak and Hold Injector Drive

The circuit diagram shown (Figure 2) is one of many different variations of the peak and hold circuit, but works the same as most of them. From the start of an injector pulse, the circuit works about the same. The analog circuit relays the logic 'High' signal to the base of the transistor, which fully saturates it, causing the collector to short to the emitter. (Note that the analog circuit acts as the resistive element to protect the logic components). One difference in this circuit is the 0.1 ohm resistor in series with the emitter. It allows for a slight voltage drop (signal Z, which ramps up to 0.5 volts) in the circuit. This voltage is proportional to the current through the injector and is monitored by the analog circuit. When the analog circuit sees a predetermined voltage level (0.5v), it is assumed that the peak current has been reached and the injector is fully opened. From this point on, a much smaller amount of current is needed to hold the injector open. The analog circuit backs the transistor base voltage (signal X) off to approximately 1.4v to partially bias the transistor, thus holding the collector voltage (signal Y) at a higher level which is smaller compared to the battery voltage and therefore reduces the current through the injector. (Notice the resultant spike on signal Y from the inductive kickback of the injector coil as the current is reduced).

When the analog circuit backs the base voltage off, it goes into a loop mode, continuously modifying the base voltage to hold the feedback voltage (signal Z) at 0.1 volts. This is accomplished using a fast op amp inside the analog circuit. One could calculate the current through the injector, which is equal to the current through the 0.1 ohm resistor using Ohm's Law:

I(Current) = V(Volts) ÷ R(Resistance).

I = 0.1 Volts ÷ 0.1 Ohms = 1 Amp

The reduction in current through the transistor and the injector will result in a reduction in heat on these components, and therefore increase their work life, which is the reason for the Peak and Hold Injector Drive.

In the next Tech Tip, we will take a closer look at the injector patterns themselves and what we can determine from them.

GM Linear EGR Valves Experience Carbon Clogging

The GM Linear EGR Valve can be prone to carbon clogging.

This carbon buildup can cause the EGR pintle to stick open or closed. This results in rough idle, stalling, hesitations, surging, pinging, malfunction indicator lamps (MIL) to be set, or failed emissions.

A new EGR valve may very well foul again in a short period of time.

Tomco has developed an EGR screened that fits most GM Linear EGR Valves.

The *Kleen-Screen™ Gasket* takes the place of the original equipment type gasket. The screen is placed over the hole where the exhaust gas enters. The heat resistant screen catches the carbon particles before they can cause trouble.

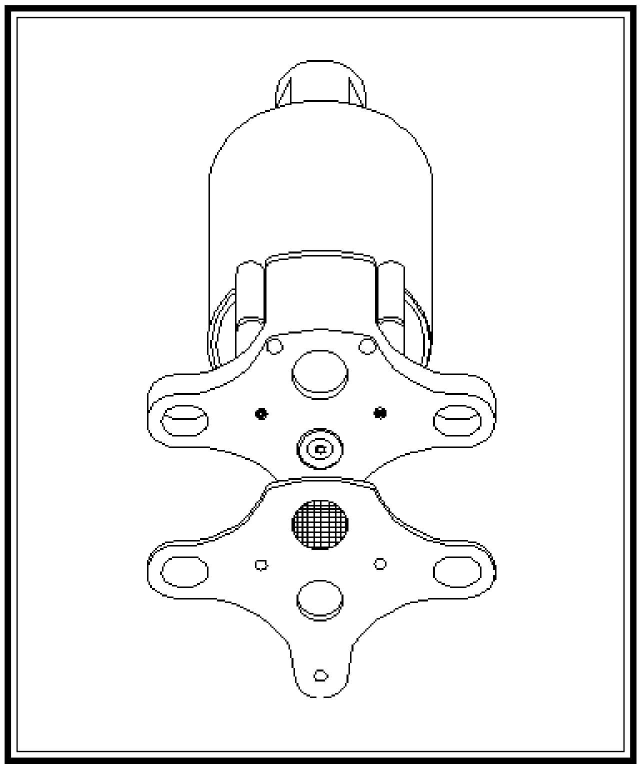

Figure 3

Be sure to clean the EGR pintle, seat and passages when installing the gasket.