Module 22
Ignition Systems - Outputs

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22 Ignition System – Outputs

22.1 General Overview

The ignition systems used by Honda over the years have gone through a lot of changes. The ignition systems on the earliest PGMFI systems controlled ignition advance mechanically and had no electrical connection to the ECM.

Image 22-1 Typical Honda Electronic Dist

In 1988 the Civic distributor went full electronic with the Accord following in 1990. These ignition systems have no mechanical advances and the ECM has total control over the ignition coil's primary current.

This training manual will limit its focus to the electronic distributor models.

The total ignition system is covered in two chapters. This chapter will cover ignition outputs. Chapter 16 will cover ignition signal inputs. For information about the PCM input signals, CYL sensor, CKP sensor, TDC sensor, etc, see Chapter 16.

22.2 How Does The Ignition Output Work?

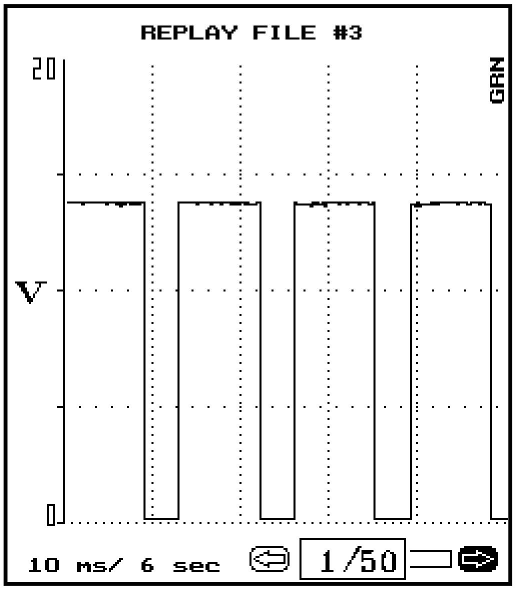
Image 22-2

This chapter focuses on the output side of the ignition system. We will begin with the ECM/PCMs "output" to fire the sparkplug. To learn more about the input signals and how the ECM/PCM decides when to spark the plug, see Chapter 16.

When the ECM/PCM has decided it is time to fire a sparkplug, it signals to the igniter to interrupt the ignition coil's primary current. This interruption of coil current causes a magnetic field inside the coil to collapse across a secondary winding which in turn produces a high tension voltage for the spark.

The igniter produces a voltage (10.5-12 volts) on the first lug on the left (refer to

Screen Capture 22-1 ECM Trigger



Screen Capture 22-2

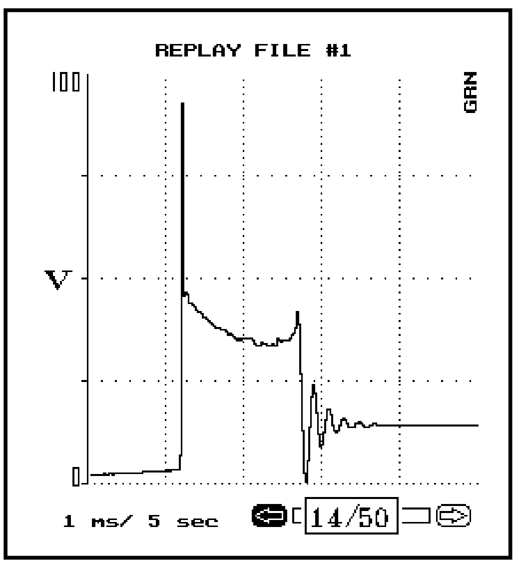


Image 22-2). When the ECM/PCM wants the plug to fire it will pull that voltage to ground. While this wire is grounded by the ECM/PCM, the igniter interrupts the coil's current. When it is time for the coil's next saturation period to start the ECM/PPCM will release the ground.

Screen Capture 22-1 shows the wave-form of the igniter to ECM/PCM wire. At the point where the voltage is pulled vertically to ground, the plug will fire.

During the time the voltage is at the high voltage, current is flowing through the ignition coil and preparing for the next discharge.

The loss of the igniter produced refer-ence voltage will set a DTC 15 on some model Hondas.

The second leg from the left is the power wire. It always has a black / yel-low stripe wire attached to it. This wire is easy to identify externally and is the wire you will use if you want to meas-ure the coil's current.

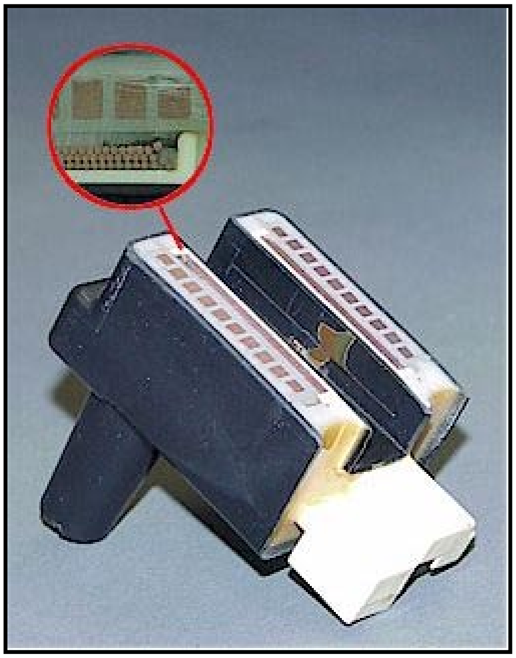
The third wire from the left is the wire that goes to the ignition coil's (-) termi-nal. This wire carries the ignition coil's current.

The fourth wire from the left (and it comes in horizontally) is the engine speed wire. It is usually blue and it goes back to the dash area to be used by the tachometer. The signal found on this wire is the same as the ignition coil's primary signal and is shown in Screen Capture 22-2.

22.3 Ignition Coil

22.3.1 Location / Construction

Image 23-3



The ignition coil may be mounted internal of the distributor or mounted external of the distributor. This varies among models and engine families. The external coils are somewhat larger and use a heavier gauge wire for the primary current.

The ignition coils are constructed with a primary and secondary winding. The primary winding has fewer windings, yet a much heavier gauge wire.

When the current is interrupted the magnetic field produced by the primary winding current flow collapses across the secondary windings. This induces a high tension voltage into the secondary windings that could exceed 40,000 volts.

Image 22-3 shows a cut away of a Honda ignition coil. In the detail view you can see the primary and secondary winding. The secondary winding is so fine you cannot distinguish the individual coils.

The coil shown in Image 22-3 is a defective coil. It has had coil-to-coil shorting, which can be seen in the detail view.

Image 22-4

22.3.2 Ignition Coil Testing

There are several approaches to determine if the ignition coil is performing correctly. The basic concept is that the coil should produce approximately 40,000 volts when it is triggered correctly by the igniter.

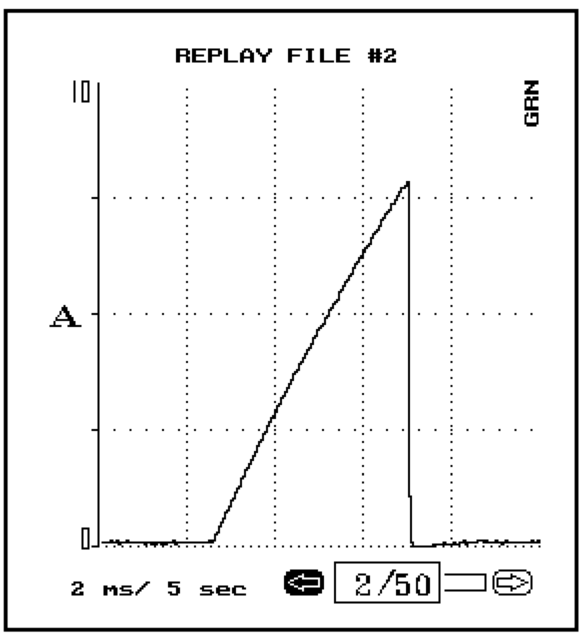
One approach is to determine that the igniter is correctly “triggering” the primary winding by looking for a dwell signal on the coil’s primary winding. This approach is somewhat effective, yet there is a better more thorough approach.

The best way to test the condition of a coil is to use a DSO equipped with a milli-amp probe. This set-up is shown in Image 22-4. The arrow is pointing to the milli-amp probe. This way you will be able to actually confirm that the coil current is being controlled correctly. This test is also able to detect coils that are prone to fail.

Amp testing is quick and "non intrusive". You do not have to back probe wires to get a reading. You simply clamp the inductive lead over the wire you want to test and the current is displayed on the DSO in the same format as voltage is. The current is displayed over time.

Ignition coil testing is extremely easy since the power feed wire has always been a black wire with a yellow stripe. When checking the internal coil units you do not need to pull the cap, simply clamp on the black / yellow stripe wire that is in the distributor connector.

Screen Capture 22-3 Good Coil Waveform



When you use a milli-amp probe to measure ignition coil current you will get a pattern similar to the one shown in Screen Capture 22-3.

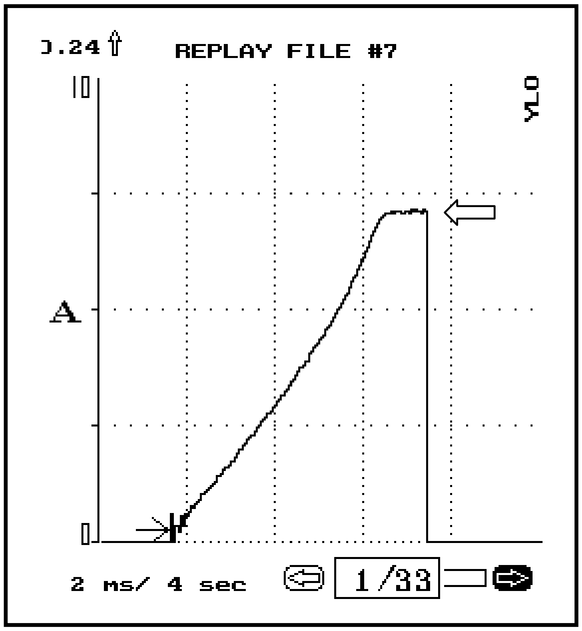
This waveform is representing the actual current flow through the coil's primary winding. Notice that when the current is "turned on" it does not immediately start flowing at full current, but it increases at a linear rate.

There is a lot of information in these waveforms and many new diagnostic procedures are being developed that use current waveforms instead of voltage waveforms. This is often referred to as "amp ramping" within the automotive industry.

When you scope the ground side voltage of a load device you can indeed confirm that the device was grounded and for how long. When you scope the device's current flow you can tell this, plus determine the condition of the load device's electrical winding.

With a current waveform you can determine total current flow. If the current flow is too high it may be a sign of a shorted winding, and if the flow is too low it may be a sign of excessive circuit resistance.

Screen Capture 22-4 Good Coil Waveform

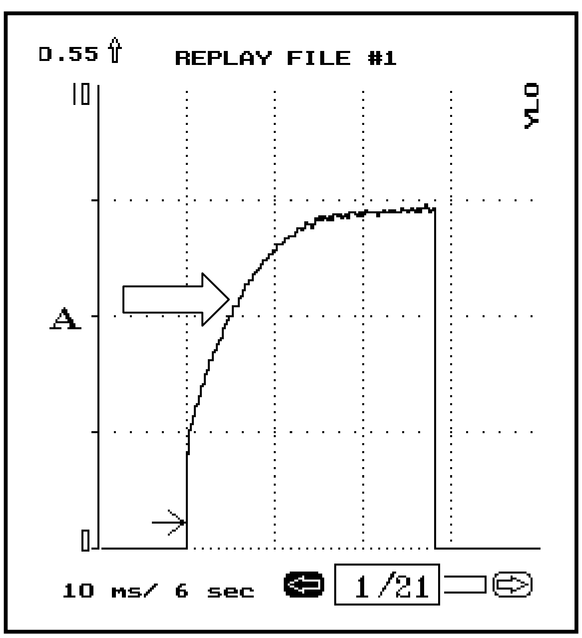


The slope and shape of the ramp can tell you a lot about the condition of the ignition coil's windings.

The reason that the current ramps up at this rate instead of instantly flowing is due to the inductive resistance of a coil's windings. When a voltage is applied across the coil the current will start to flow. When the current starts flowing through the windings the magnetic field from one winding will affect the current flow in an adjacent winding.

The end result is that a winding in addition to "regular resistance", also has inductive resistance. The inductive resistance resists current build up at an almost constant rate. Given enough time, the current will reach the saturation point of the circuit. This is when the current is being controlled by non-inductive resistance.

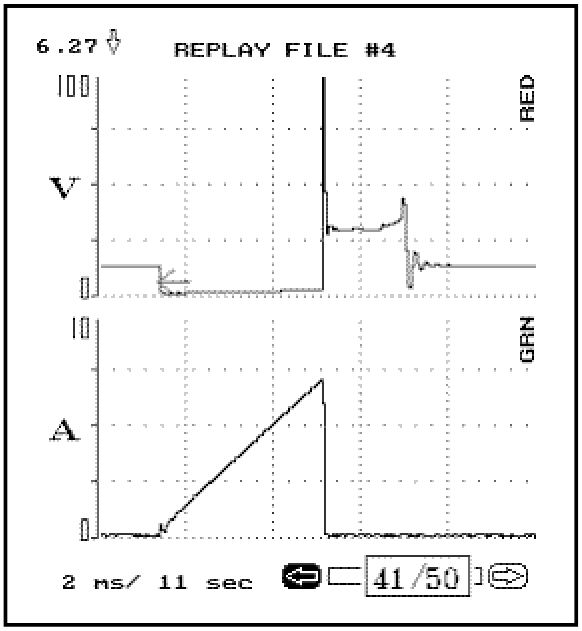
Screen Capture 22-5 Bad Coil Waveform



The Screen Capture 22-4 shows a coil that has reached saturation (at the arrow). This waveform is also a known good one. You will find some coils reach saturation and some do not. It is actually a function of dwell time, which is controlled by the ECM/PCM.

The shape and slope of the current ramp is directly controlled by the coils inductive resistance. When there is a problem with the windings, it will usually show up in the current ramp. Screen Capture 22-5 shows the amp ramp of a shorted coil. Notice the ramp "bows" out. This is an absolute sign of a defective coil. A coil showing any significant outward bowing of the current ramp should be replaced, even if it is functioning properly.

Screen Capture 22-6



Screen Capture 22-6 shows a current ramp and the ground side voltage being scoped at the same time. This makes it easier to see how the current flow affects the primary voltage.

You can see as the current starts flowing at the point that the coil ground is activated. While the coil is grounded the current continues to build up.

When the ground is released the current drops. At this point the primary voltage spikes at over 100 volts and high tension voltage is produced.

22.3.3 Ignition Coil Data

The following data has been established from extensive field work with ignition coil current ramping.

All Internal Coils (Hitachi & TEC)

Average Maximum Current Flow:	5.5 – 7.5 amps
Total Dwell Time:	3.6 - 4.1 ms
Ramp Slope:	1.7 – 2.0 amps per ms

All External Coils (TEC)

Average Maximum Current Flow:	6.75 – 8.75 amps
Total Dwell Time:	3.6 – 4.1 ms
Ramp Slope:	1.5-2.5 amps per ms

22.4 Diagnosing Honda Ignition Systems

You can test the ignition system at any part of the process. You could start at the beginning and check the distributor input signals, then check for a PCM to igniter trigger, then check for ignition coil current and finally for ignition coil output.

Where you start is not important. Where you start is usually based on personal experiences with a particular make and model's ignition system.

Image 22-5

Many of the ignition system's components can be checked with a standard DSO. There are limitations on what you can do with a traditional DSO when it comes to secondary ignition.

To perform any significant testing on the ignition system's secondary system you will need to use an ignition analyzer such as Interro's PDA100 (shown in Image 23-5). This unit is measuring the spark KV with an inductive lead.

Scan tools are not very useful for ignition system testing.

22.5 Service Issues

22.5.1 On Coil Failures, Check Secondary Voltage

Some of the older Hondas (88-89 Accords) were bad to have the ignition rotor fail. They would allow the high tension voltage from the coil to arch to ground. While the thickness of the insulation of those rotors may have been marginal, many of the failures could be attributed to wide spark plug gaps. The wide gap required that the coil produce a much higher secondary voltage to jump the gap, which over time could cause a premature ignition rotor failure.

The late model ignition systems that are having coil failures could have a similar problem. It the secondary ignition system has to produce a much higher voltage than normal over a long period of time, it too could cause ignition coils to fail prematurely.

Anytime a secondary ignition component fails, you should check for any condition that would cause the secondary ignition to be higher that normal.