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# Coil On Plug Ignition: The Wired Differences

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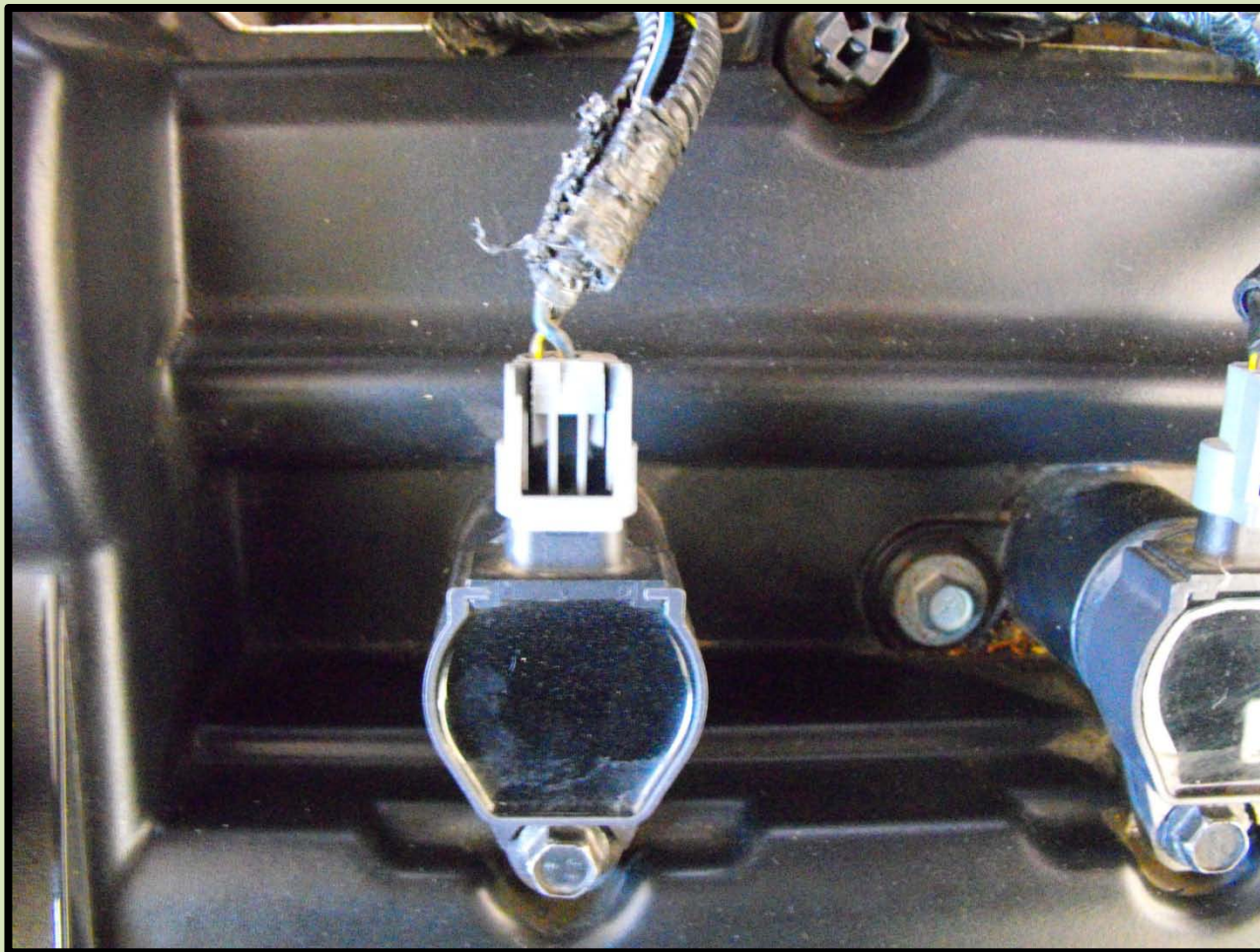
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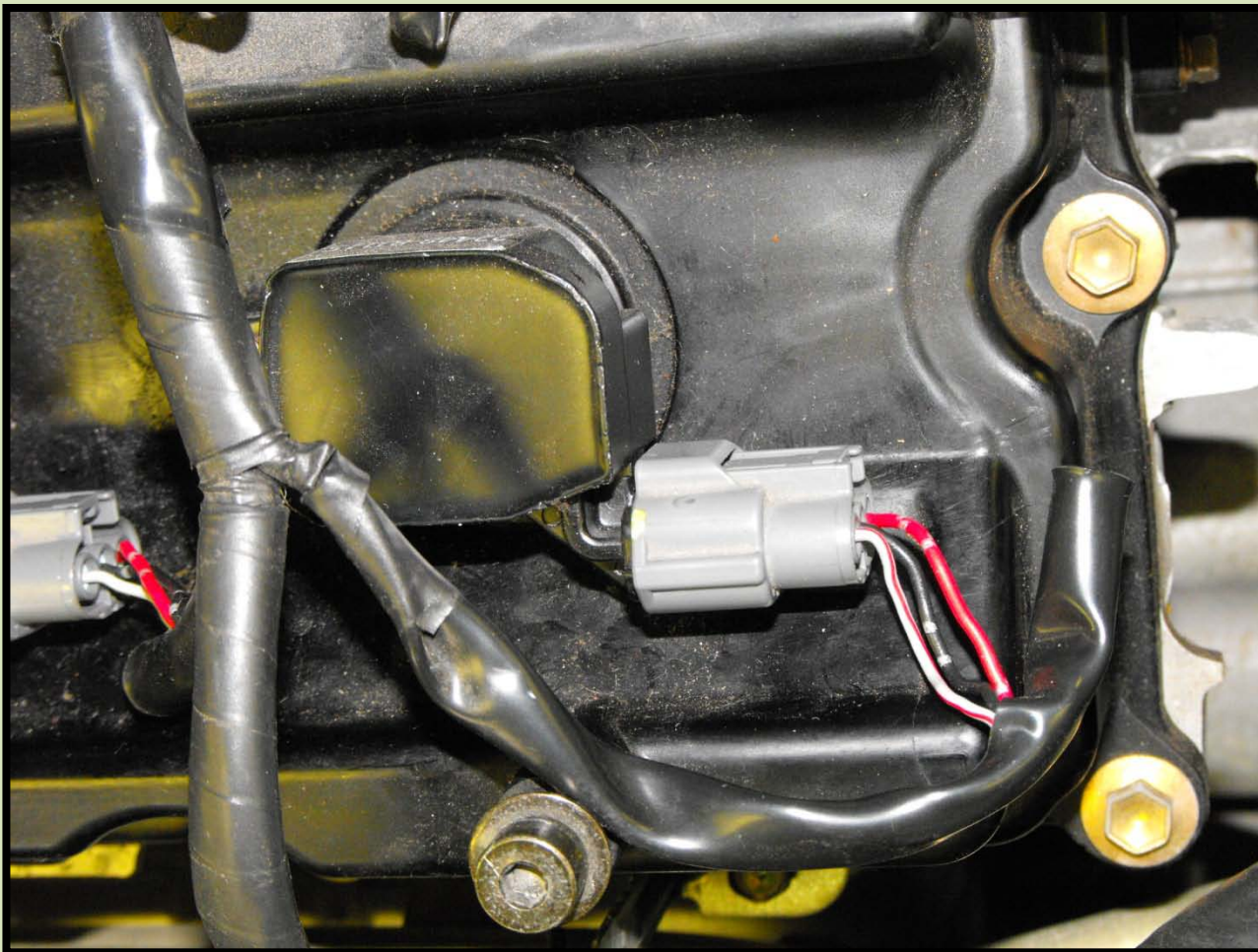
# **Coil on Plug: The Wired Differences**

2011 ICAIA Fall Conference  
Ranken Technical College, St. Louis, MO  
Matt Dixon, Assistant Professor, SIUC

Have you noticed **2 wire coils**?



Have you noticed **3 wire coils**?



# Have you noticed **4 wire coils**?



How are they different?

What are good tools to  
check them?

# C.O.P. Commonality

C.O.P.'s connect to a fused 12v source

12v usually directed from a relay

These relays have varying control logic



**ASD, MFI, Main, IG2, PGM-FI etc.**

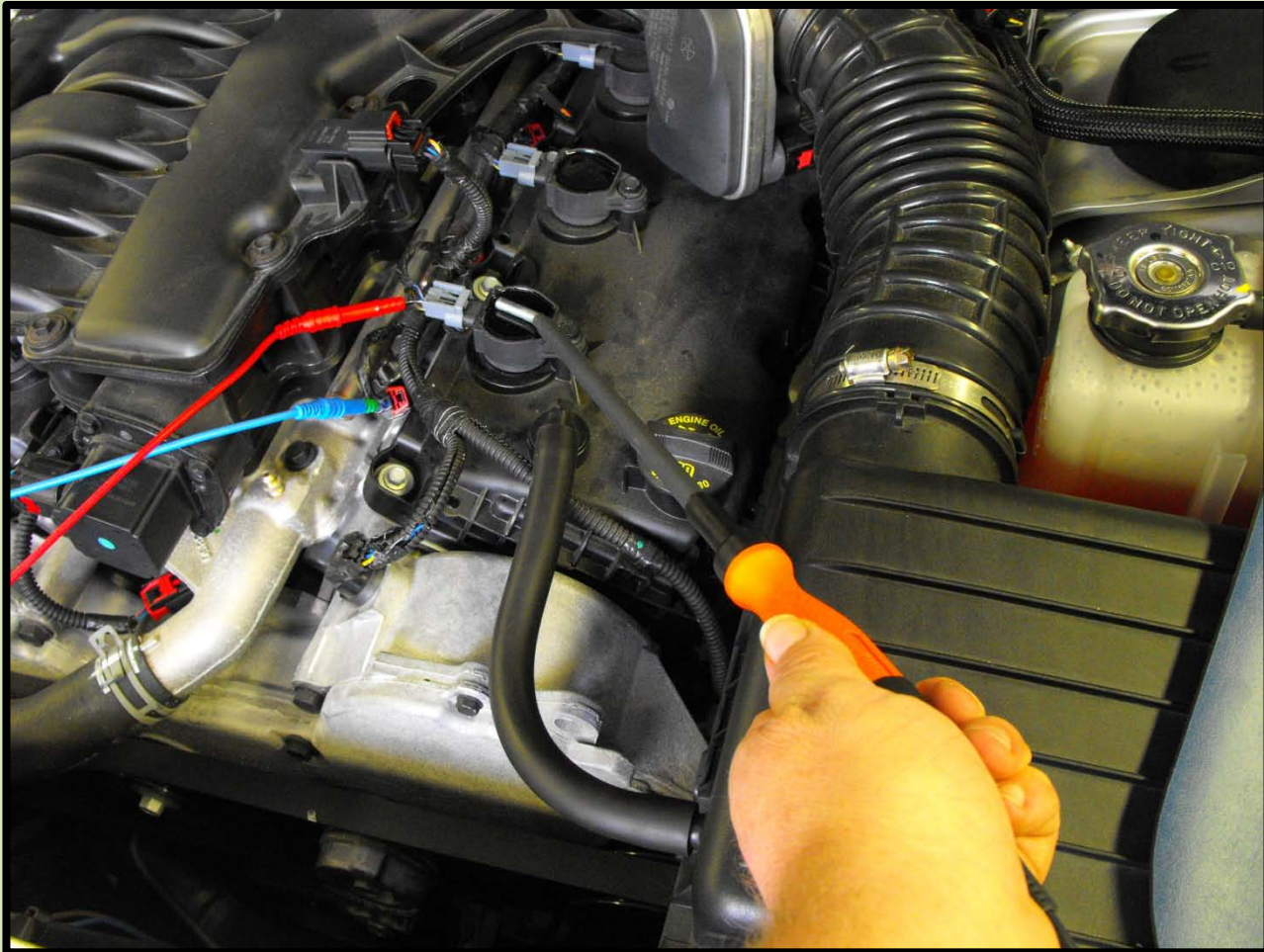


# C.O.P. Commonality: Secondary Ignition Measurement



**Obstacles in the way: the norm**

# C.O.P. Commonality: Secondary Ignition Measurement



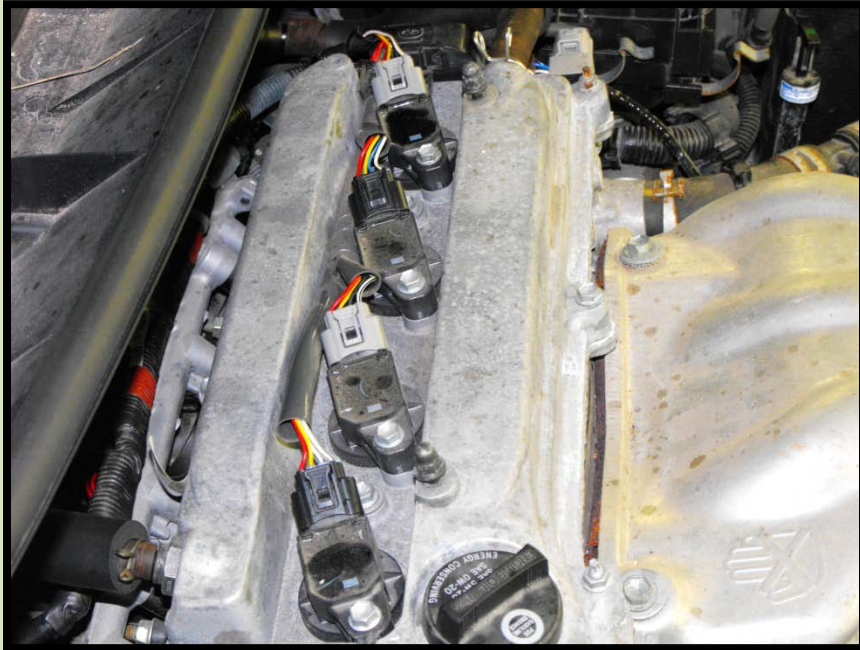
“wand” adapter may help

# C.O.P. Commonality: Secondary Ignition Measurement

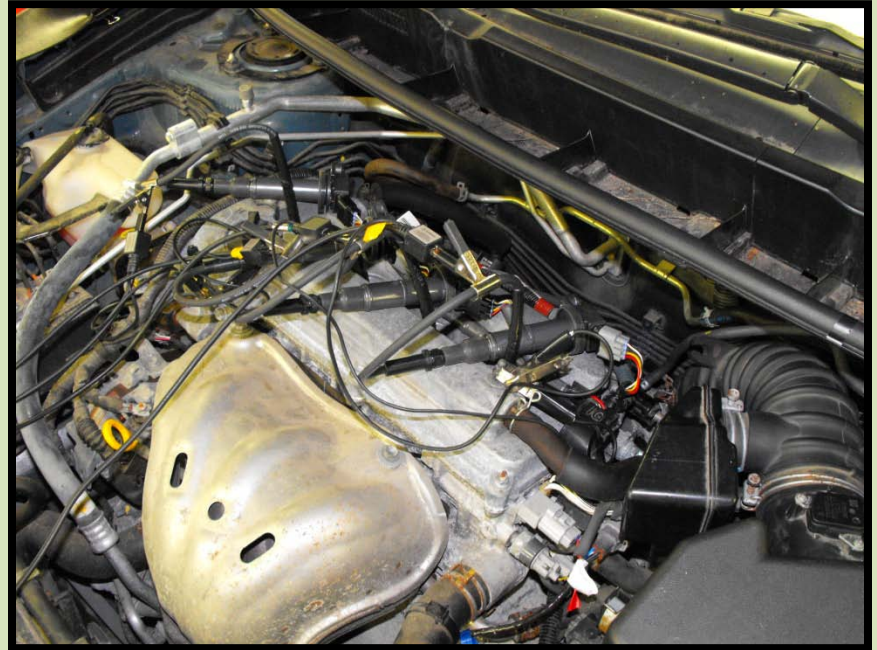


**This tool is flexible, no scope required**

# C.O.P. Commonality: Secondary Ignition Measurement

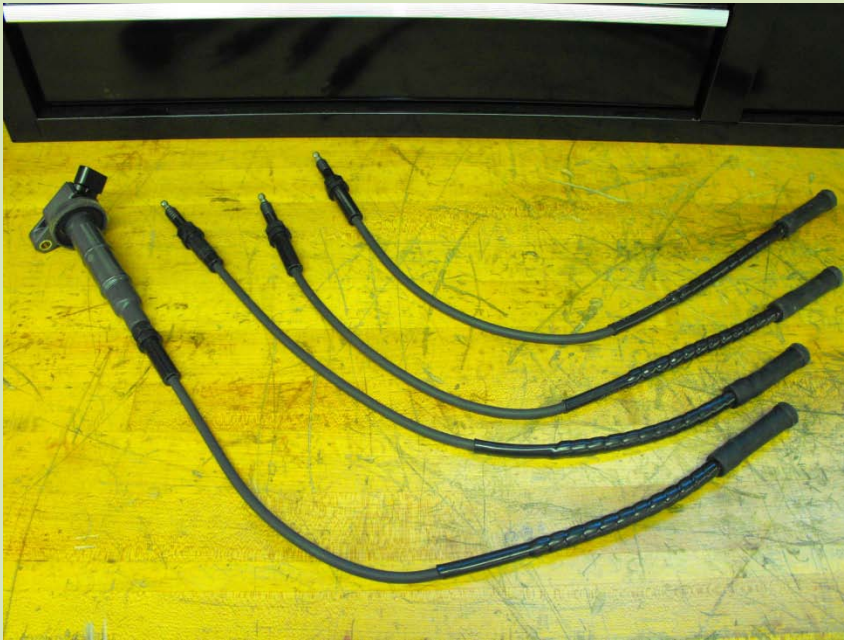


**When access is not an issue.....**



**Secondary can be checked like this**

# C.O.P. Commonality: Secondary Ignition Measurement

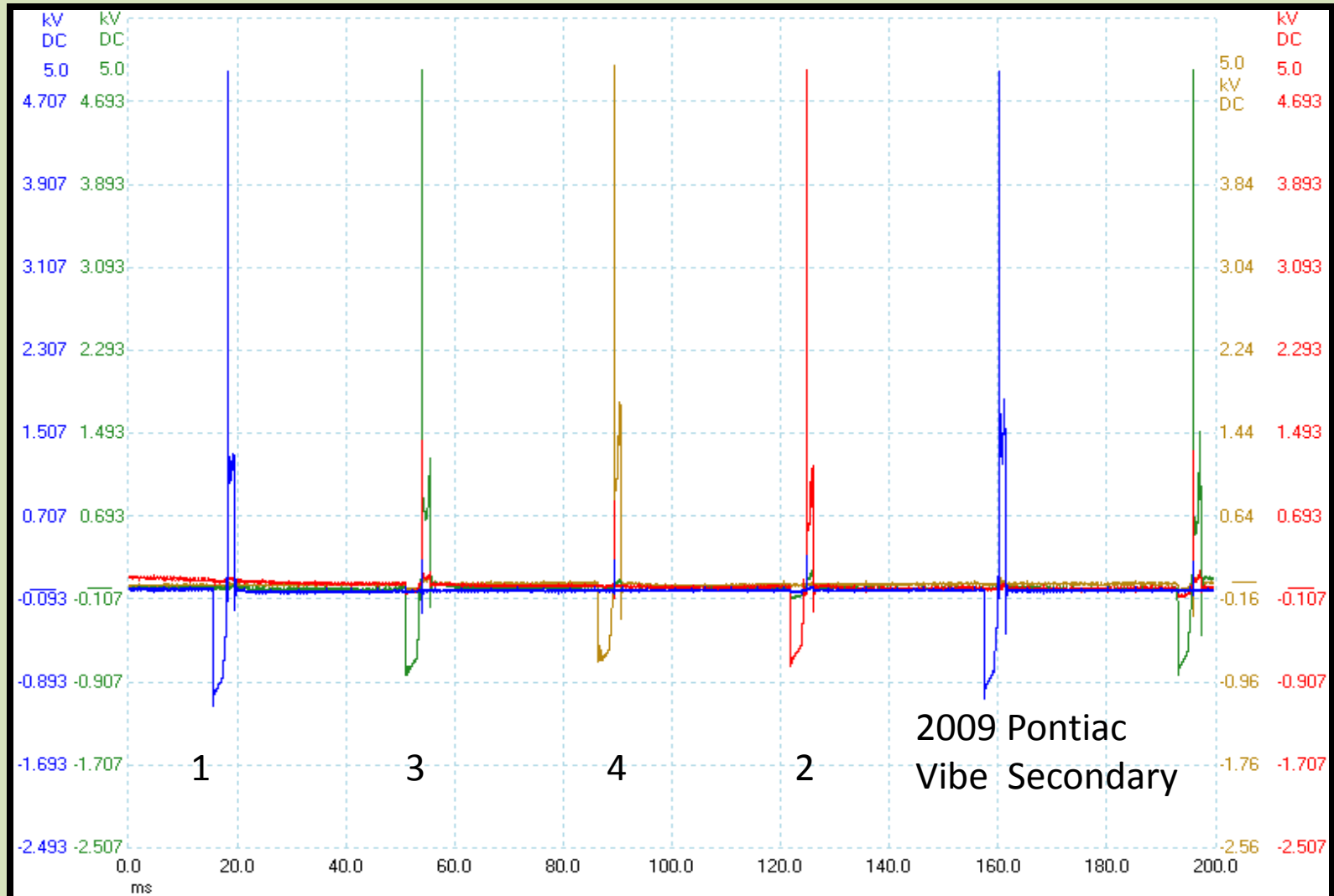


**Spark plug wire kit for C.O.P. testing**

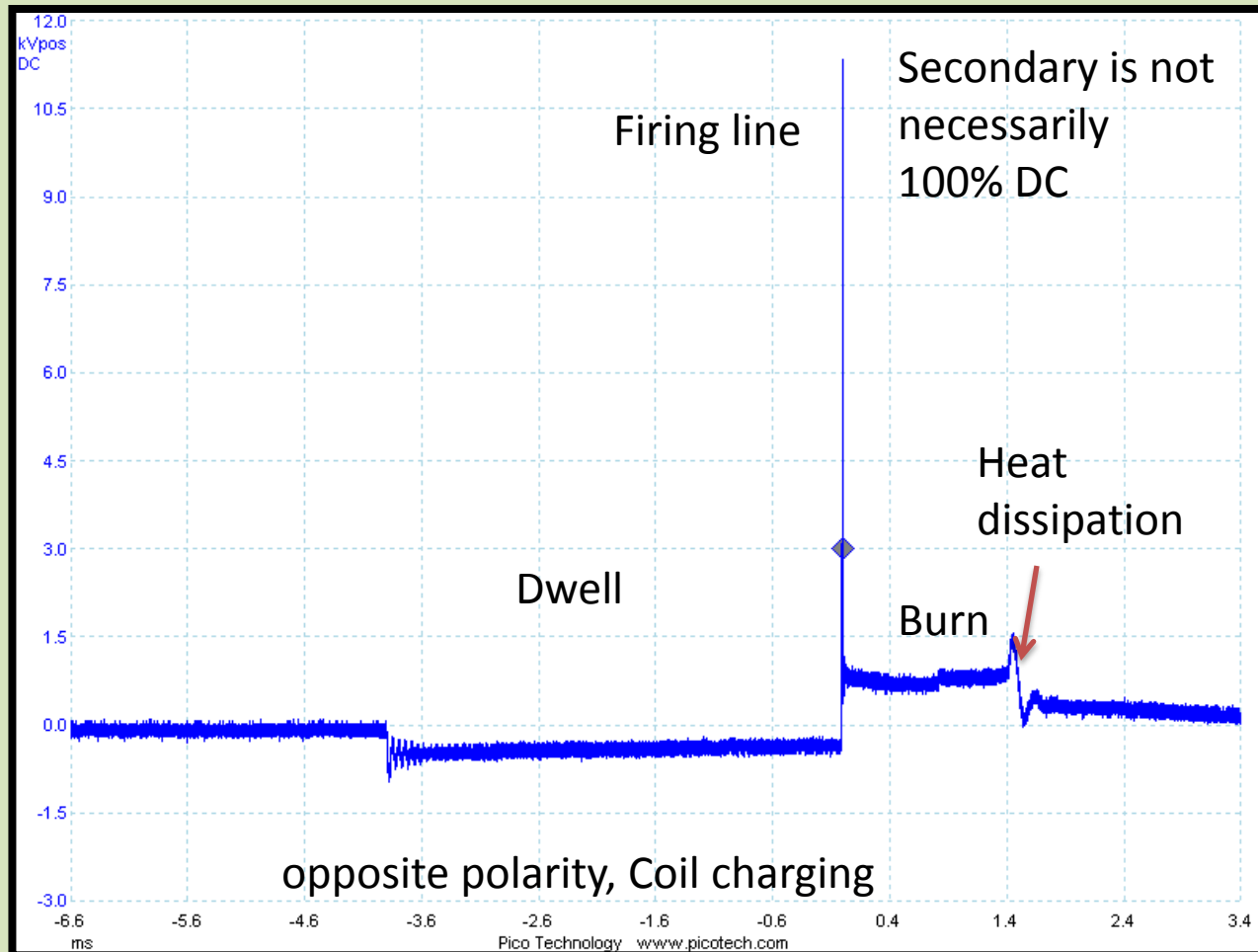


**C.O.P. Secondary testing with scope**

# C.O.P. Commonality: Secondary Ignition Measurement



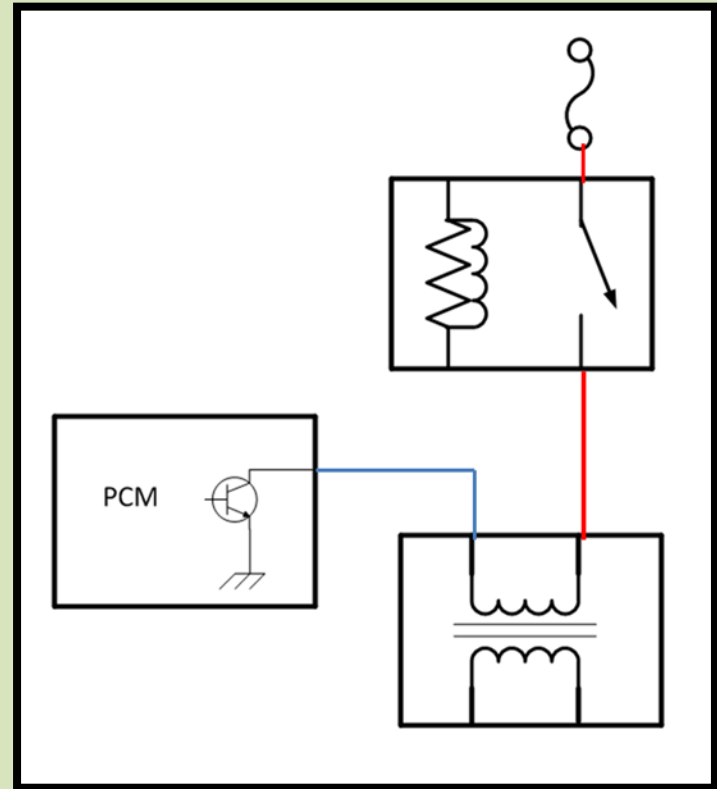
# C.O.P. Commonality: Secondary Ignition Measurement



# 2 wire coils

The 2 wires are:

1. 12 volt source
2. PCM controlled ground (dwell)

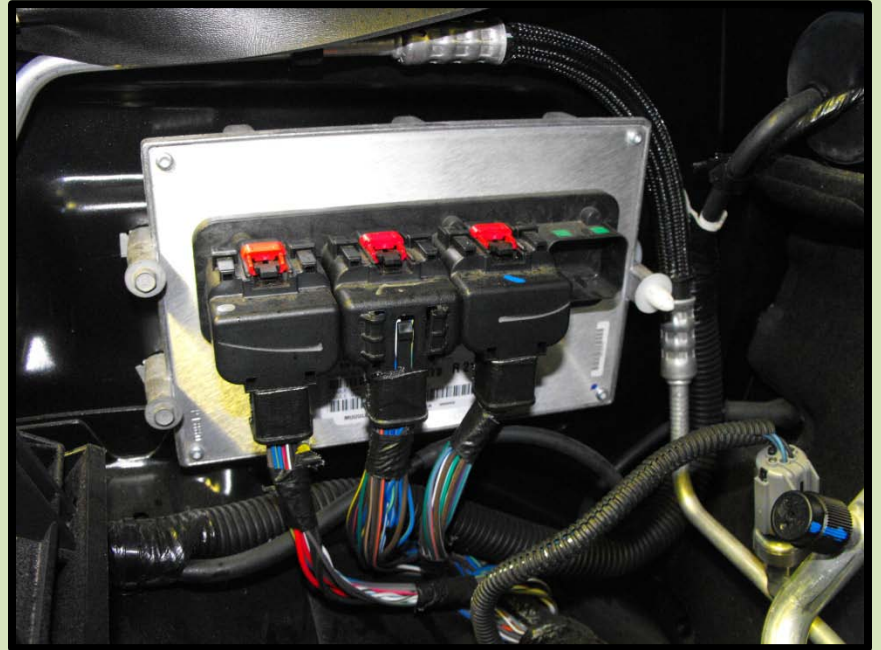




# 2 wire coils

Ignition coil dwell  
done by PCM

Offers more  
available tests



# 2 wire coils

Direct access to coil primary allows for measurement of **primary resistance**





# 2 wire coils

Many coils place a diode between the primary and secondary circuits

Secondary resistance check unavailable but **diode check** is possible



# 2 wire coils

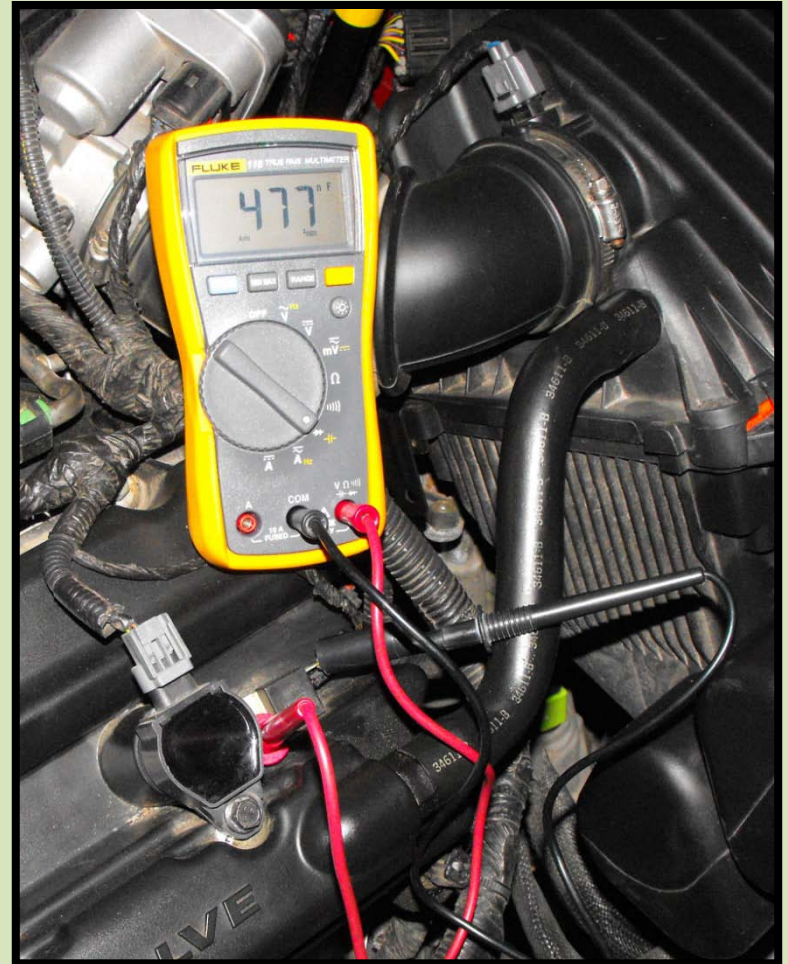


2 styles of coils that fire 2 plugs "Hemi" V-8

# 2 wire coils

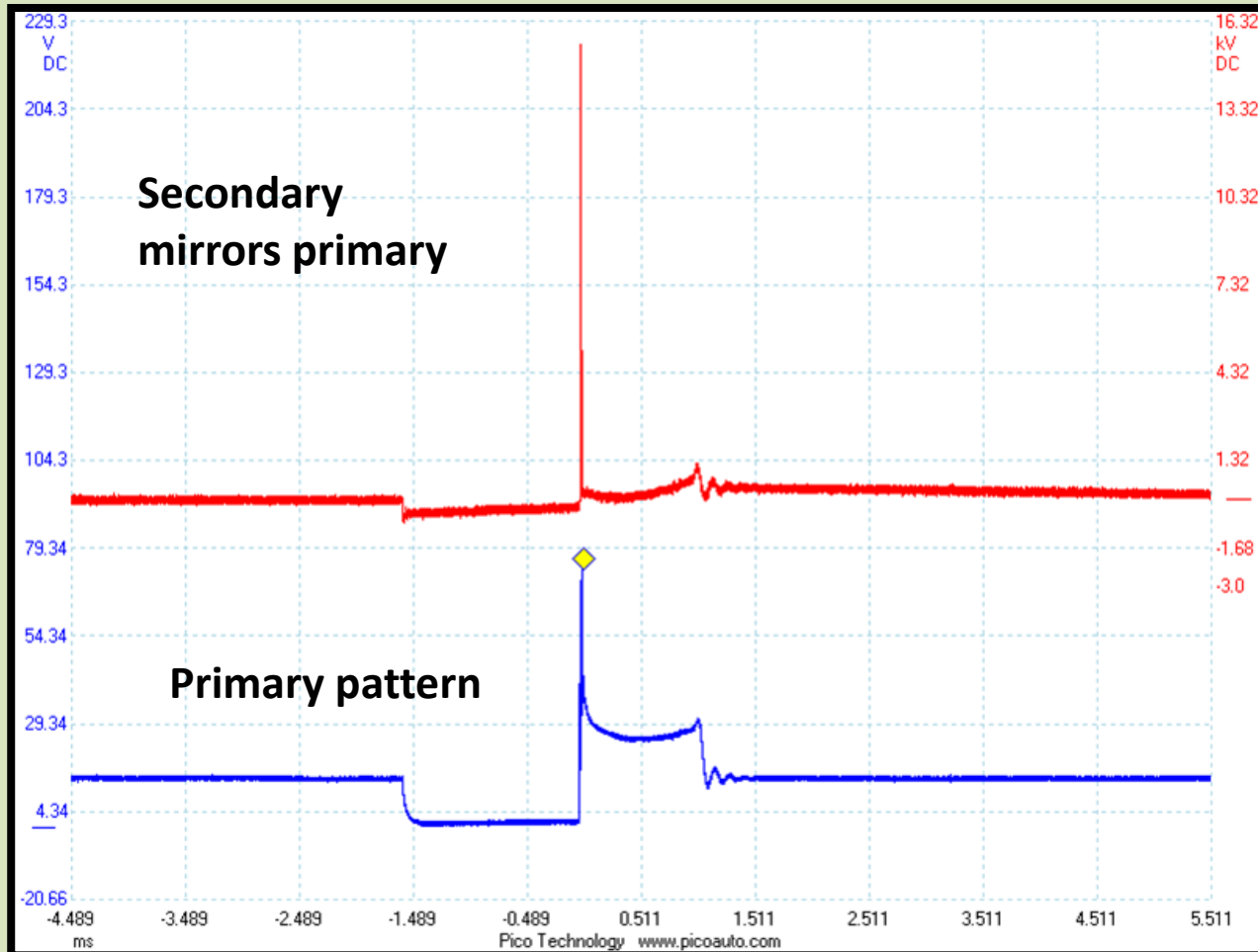
Often one or more external capacitors are utilized

Typical rating under 1 microfarad



**477 nano Farads**

# 2 wire coils: access to primary voltage

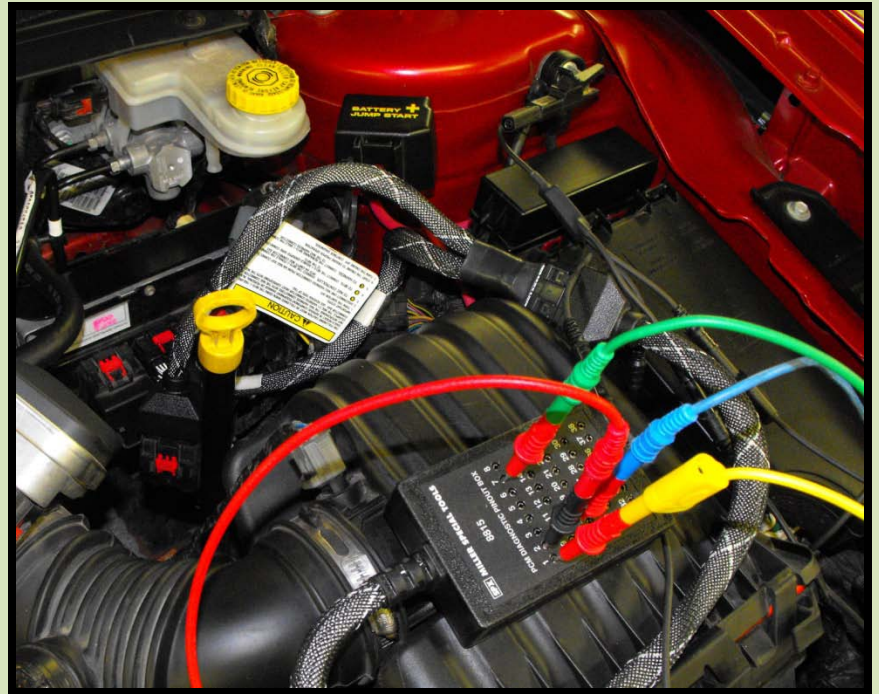


# 2 wire coils: access to primary voltage

Access the coil  
primary wires at  
the PCM

Less obstacles

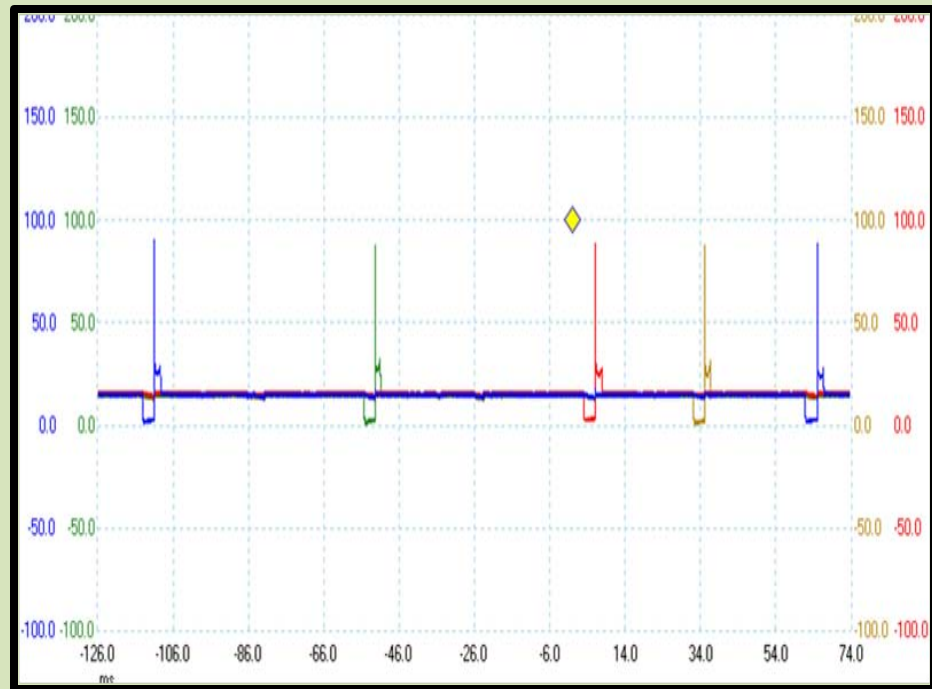
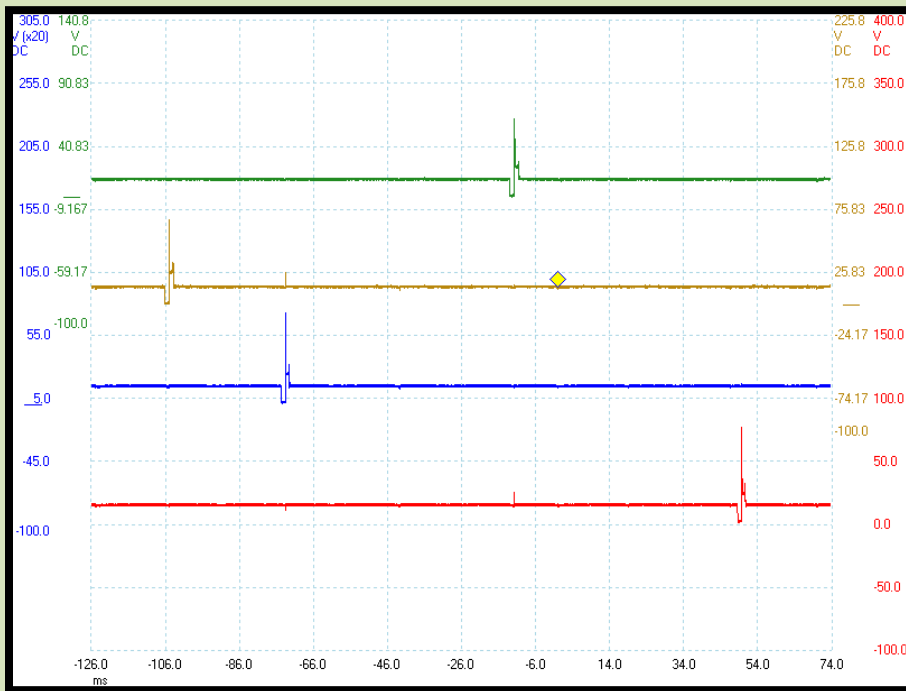
One stop shopping



**'08 Dodge Avenger PCM  
connector C2, using 8815  
pin out box**

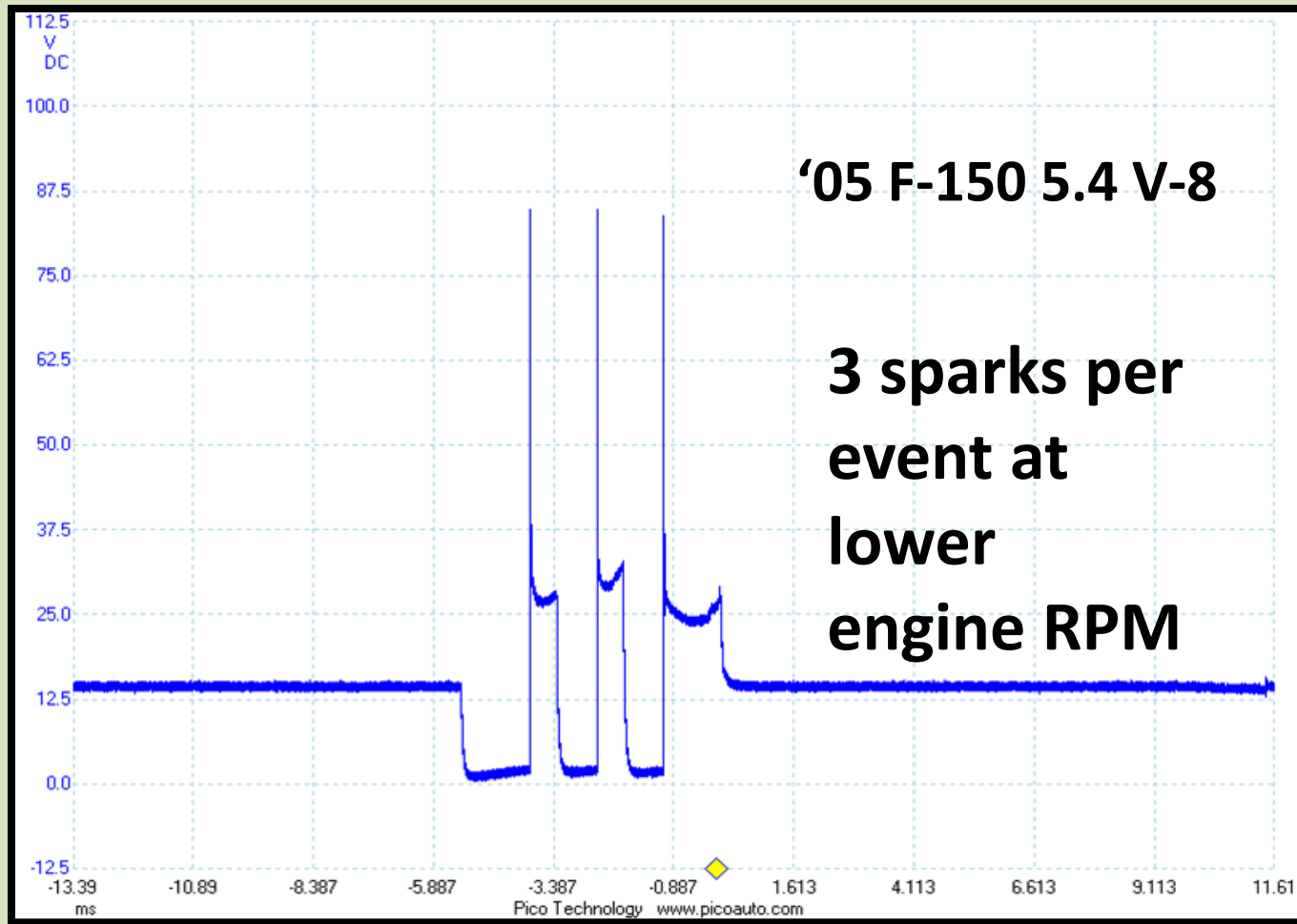


# 2 wire coils: access to primary voltage



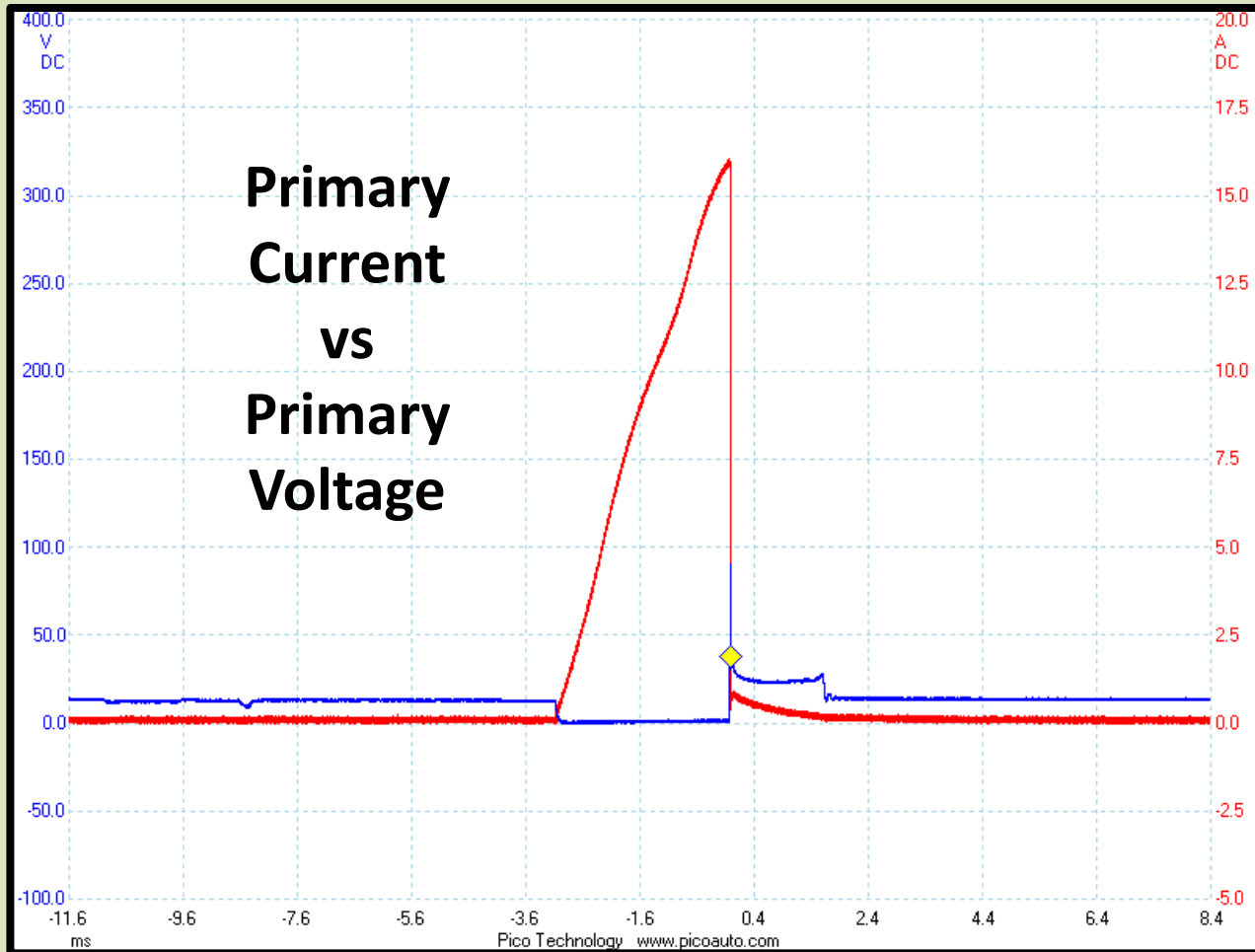
**Primary voltage pattern comparison '08 Dodge  
2.7 V-6 @ idle**

# 2 wire coils: Ford “multi-strike”



**Primary Voltage Pattern**

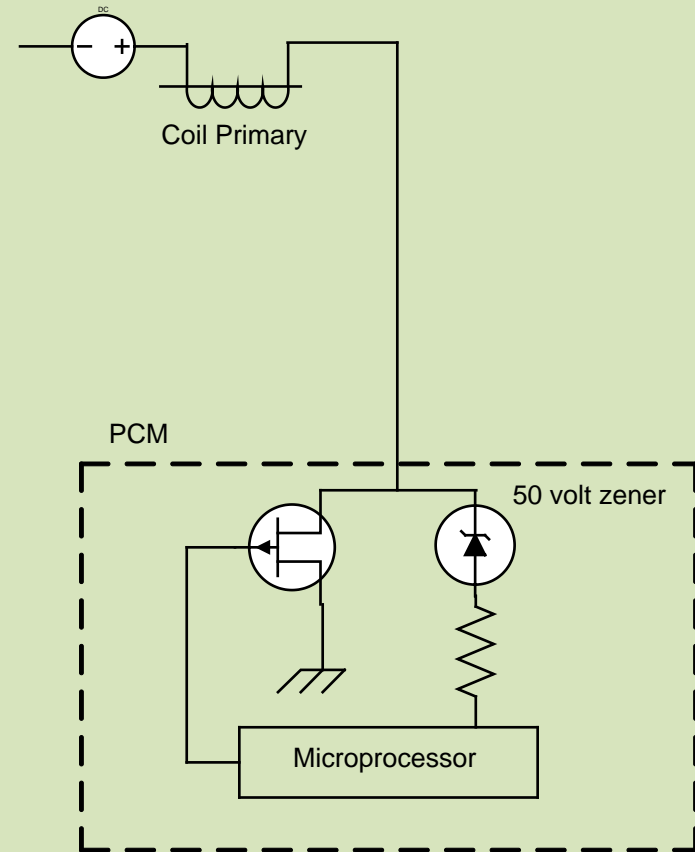
# 2 wire coils: Primary current



# 2 wire coils: vehicle self diagnostic

**zener diode** is placed in parallel to ignition dwell control in the PCM

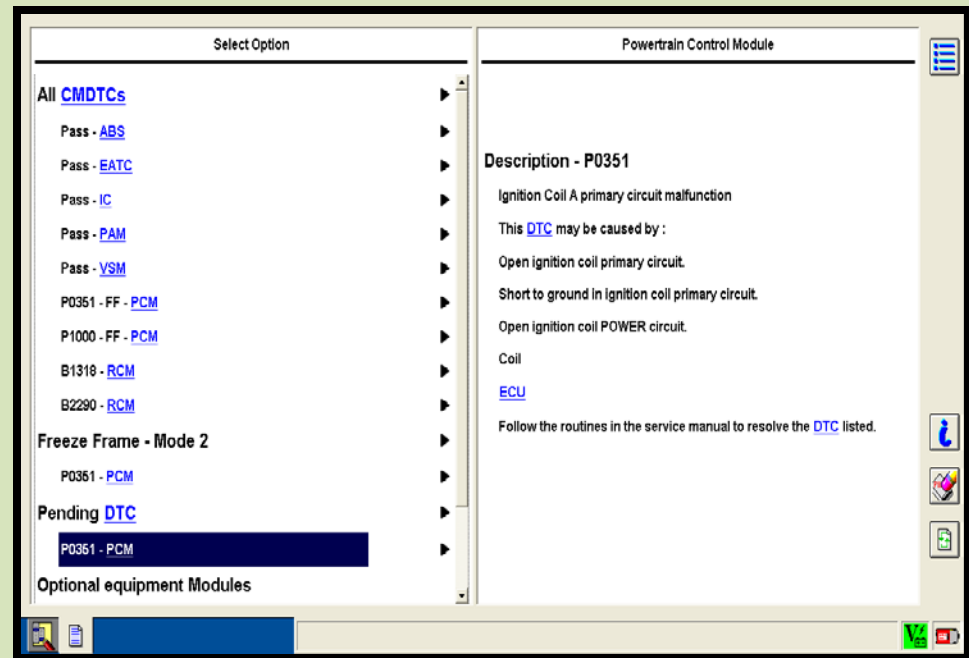
As coil is switched off, high voltage inductive kick is sufficient to cross zener acting as “confirmation pulse”



# 2 wire coils: vehicle self diagnostic

Lack of confirmation pulse results in P035x fault

Some vehicles in turn stop injector pulse to that cylinder

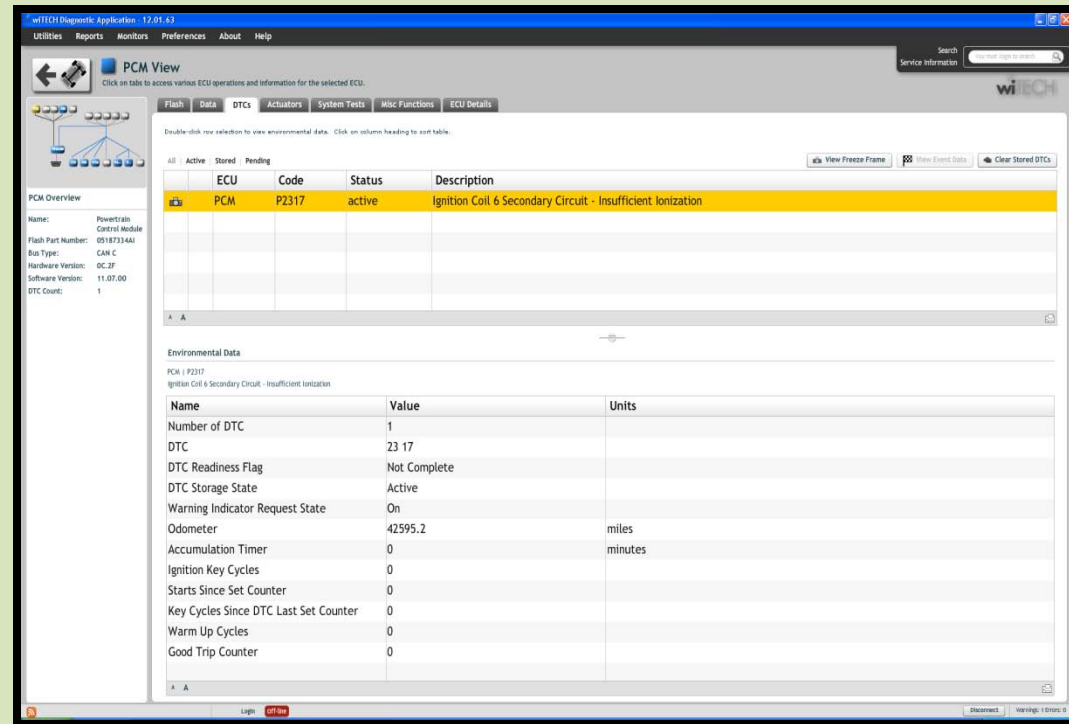


# 2 wire coils: PCM monitoring

PCM monitors dwell  
and burn time  
relationship

Insufficient Ionization  
faults

P2XXX series now add  
to P0XXX series



The screenshot shows the wiTECH Diagnostic Application interface. The main window is titled "PCM View" and displays a table of Diagnostic Trouble Codes (DTCs). The table has columns for ECU, Code, Status, and Description. One DTC is listed: PCM P2317, active, Ignition Coil 6 Secondary Circuit - Insufficient Ionization. Below the table, there is a section for "Environmental Data" for the selected DTC. This section includes a table with columns for Name, Value, and Units. The data points are: Number of DTC (1), DTC (23 17), DTC Readiness Flag (Not Complete), DTC Storage State (Active), Warning Indicator Request State (On), Odometer (42595.2 miles), Accumulation Timer (0 minutes), Ignition Key Cycles (0), Starts Since Set Counter (0), Key Cycles Since DTC Last Set Counter (0), Warm Up Cycles (0), and Good Trip Counter (0).

ECU	Code	Status	Description
PCM	P2317	active	Ignition Coil 6 Secondary Circuit - Insufficient Ionization

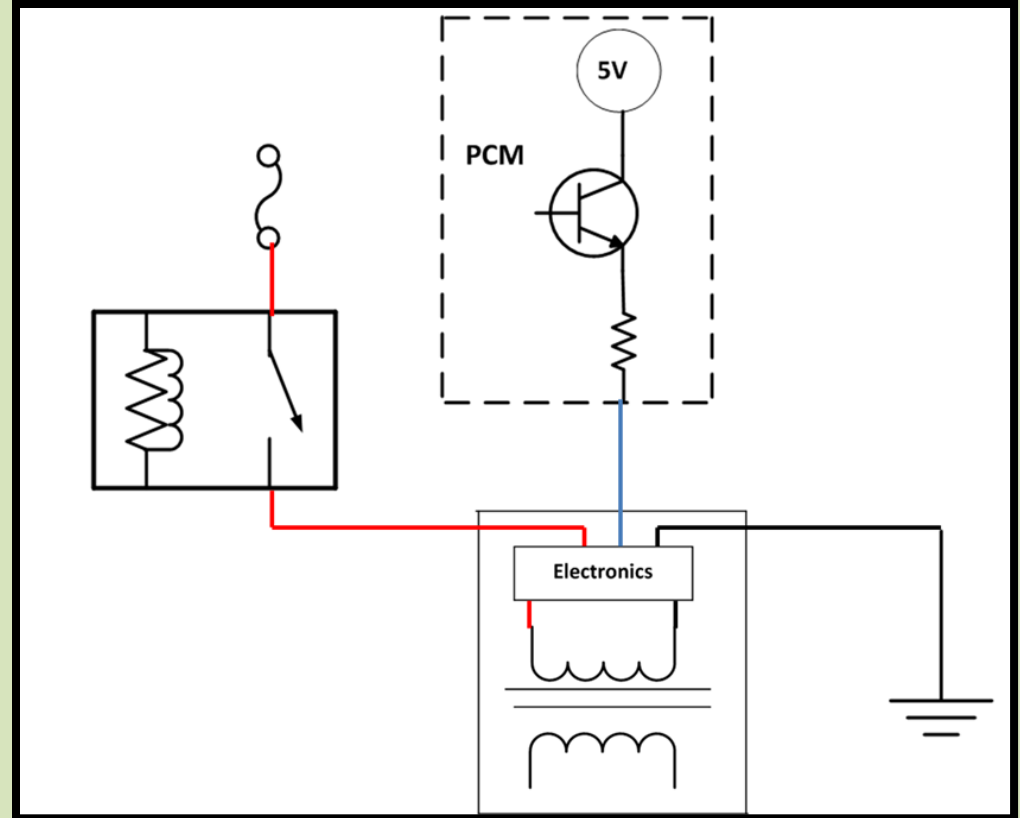
  

Name	Value	Units
Number of DTC	1	
DTC	23 17	
DTC Readiness Flag	Not Complete	
DTC Storage State	Active	
Warning Indicator Request State	On	
Odometer	42595.2	miles
Accumulation Timer	0	minutes
Ignition Key Cycles	0	
Starts Since Set Counter	0	
Key Cycles Since DTC Last Set Counter	0	
Warm Up Cycles	0	
Good Trip Counter	0	

# 3 wire coils

The 3 wires are:

1. 12 volt source
2. Ground (chassis)
3. PCM pulse command



# 3 wire coils

The coil hold down bolt/eyelet usually does not act as an electrical ground

But it does on this Chevy Trailblazer coil

Connection eyelet to chassis ground terminal



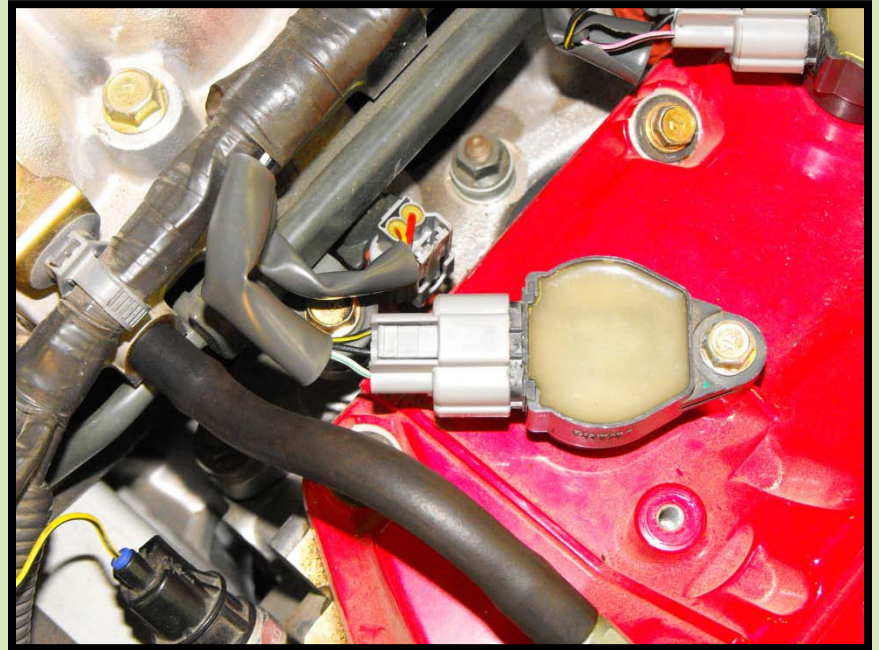


# 3 wire coils

DVOM primary and secondary resistance checks unavailable

**Primary voltage pattern unavailable**

**Primary current is available!**

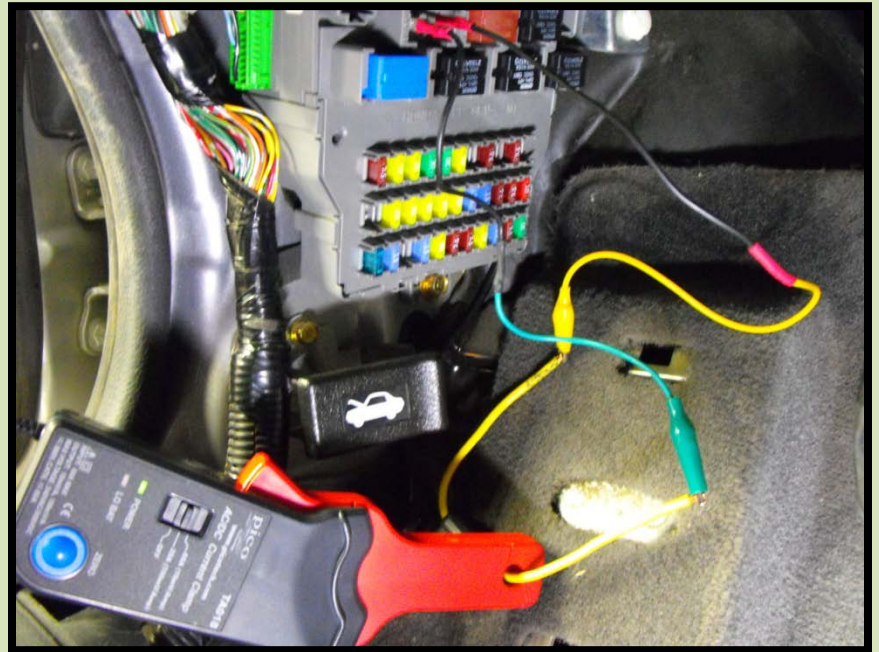


# 3 wire coils: Primary Current

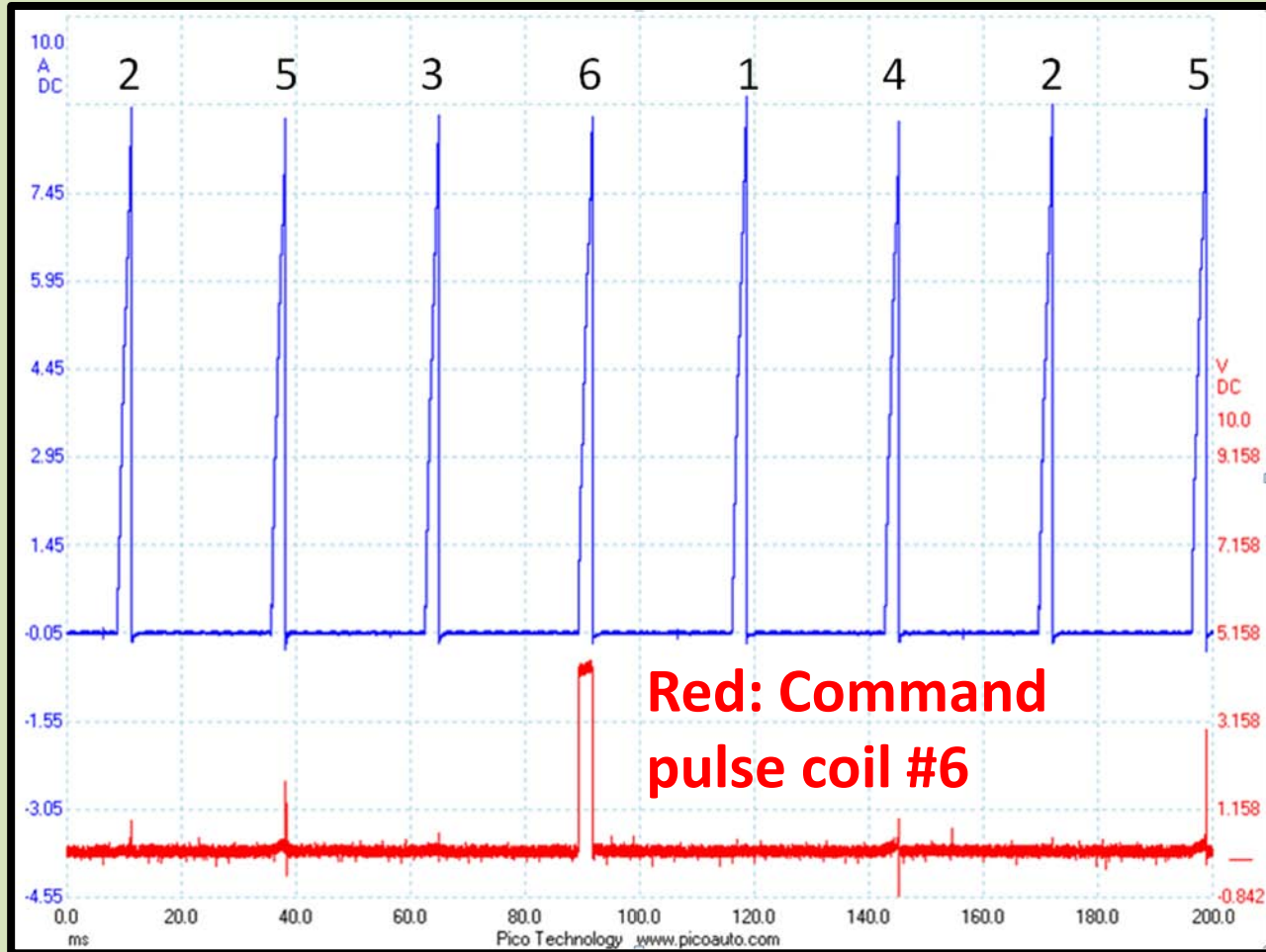
Access at a fuse or relay  
that feeds all cylinders

Jump terminals and use  
inductive amp clamp

Compare variations  
between cylinders

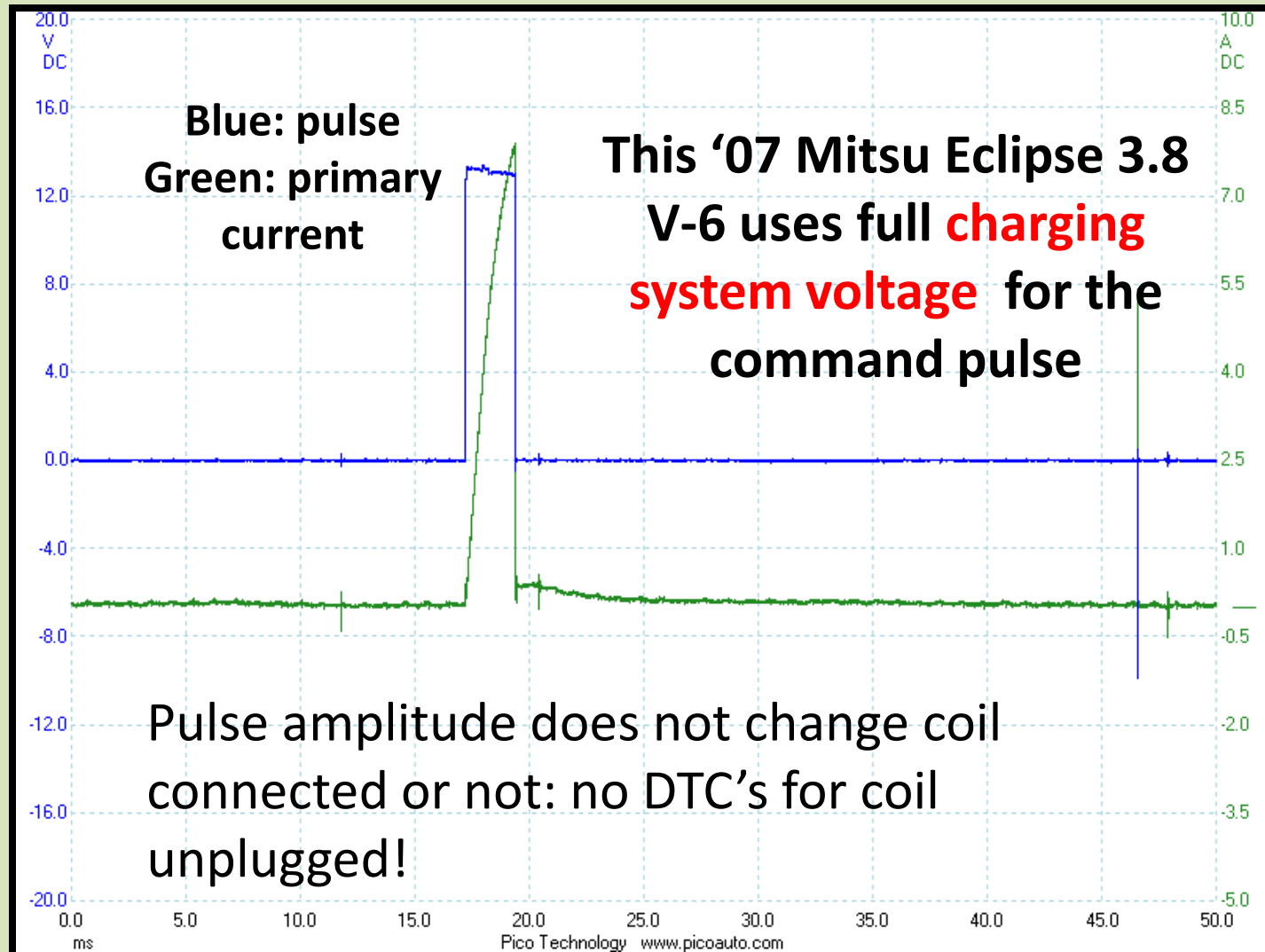


# 3 wire coils: Primary Current

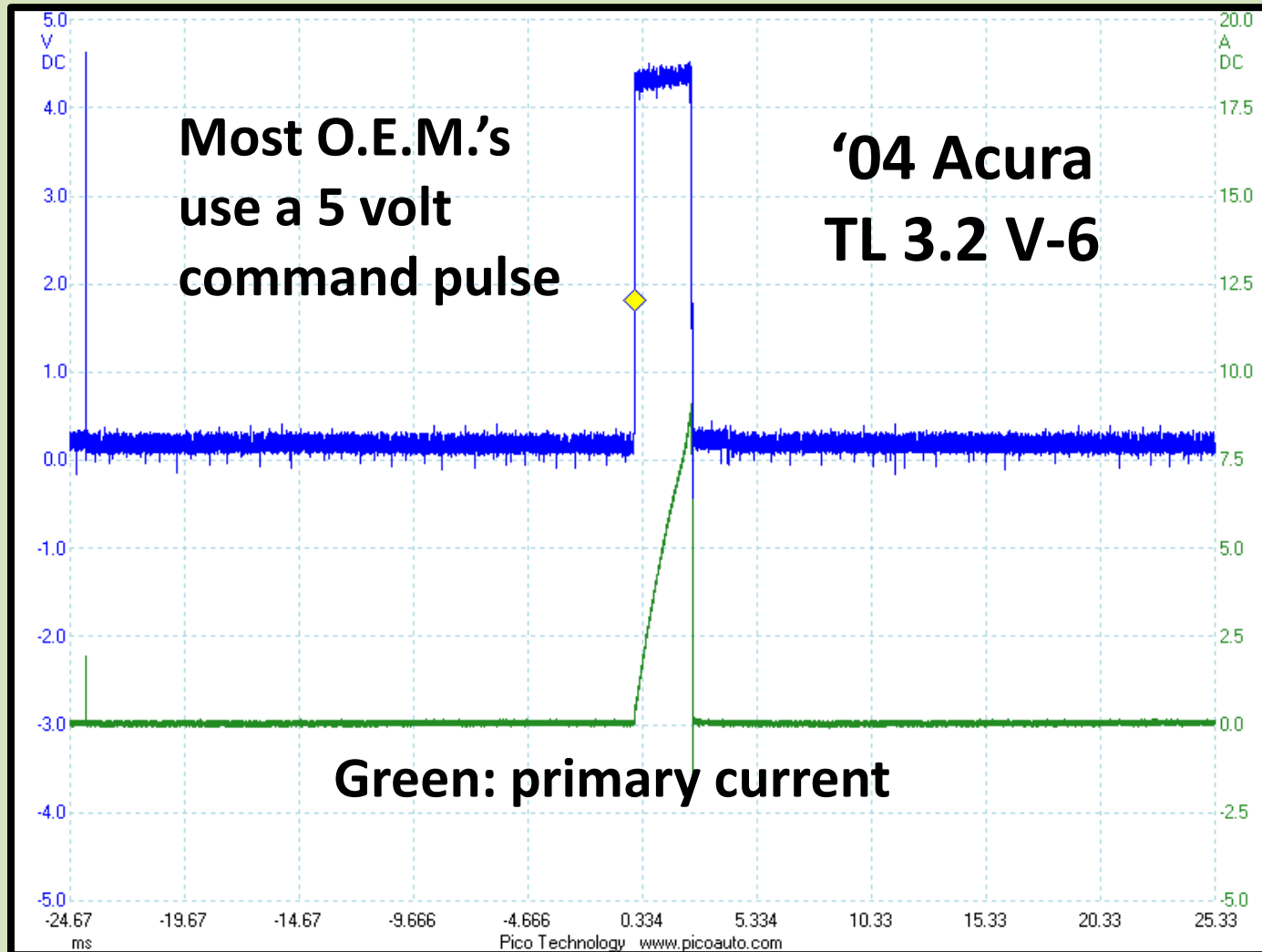


'04 Acura 3.2 V-6

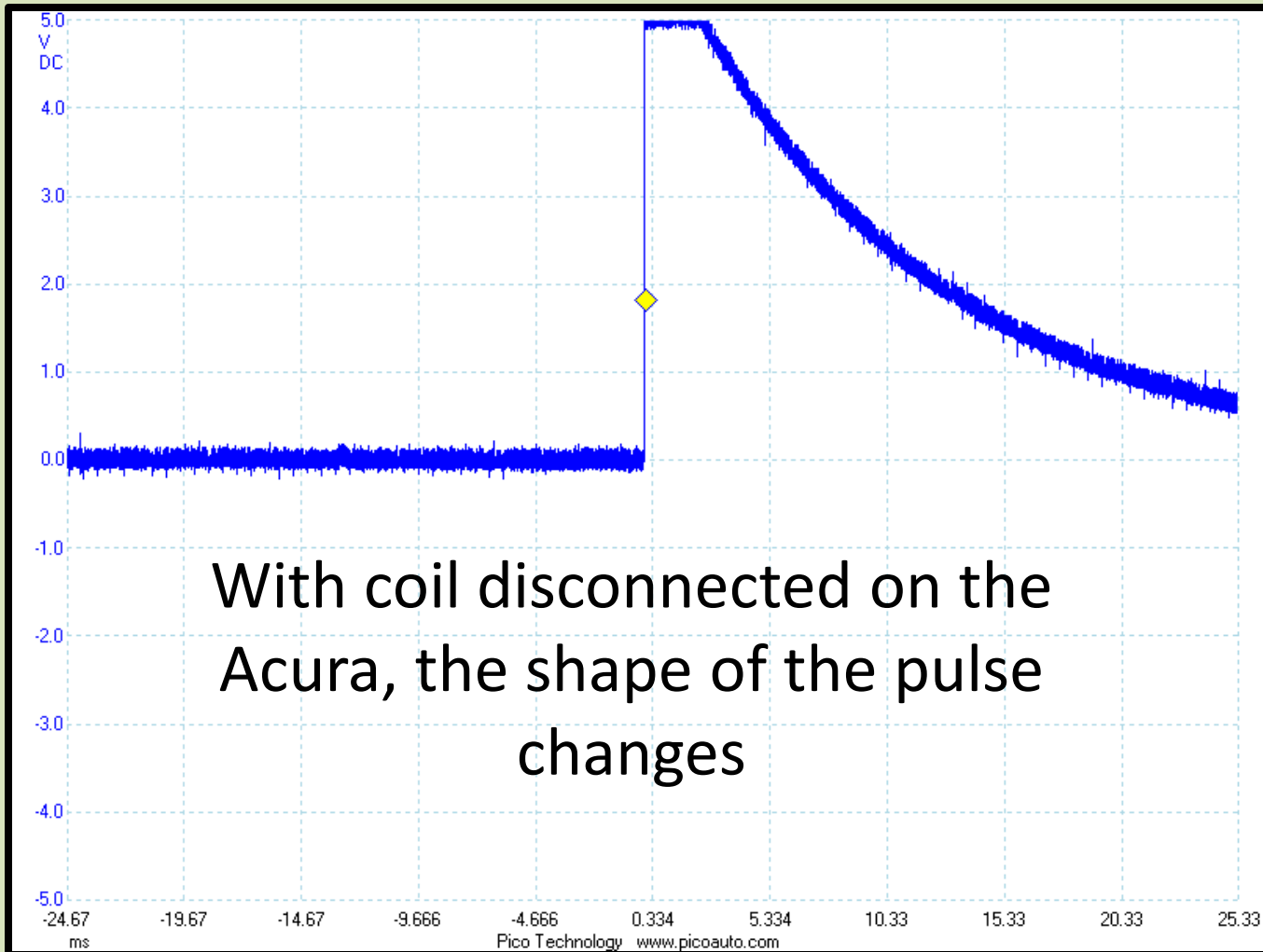
# 3 wire coils: PCM command pulse



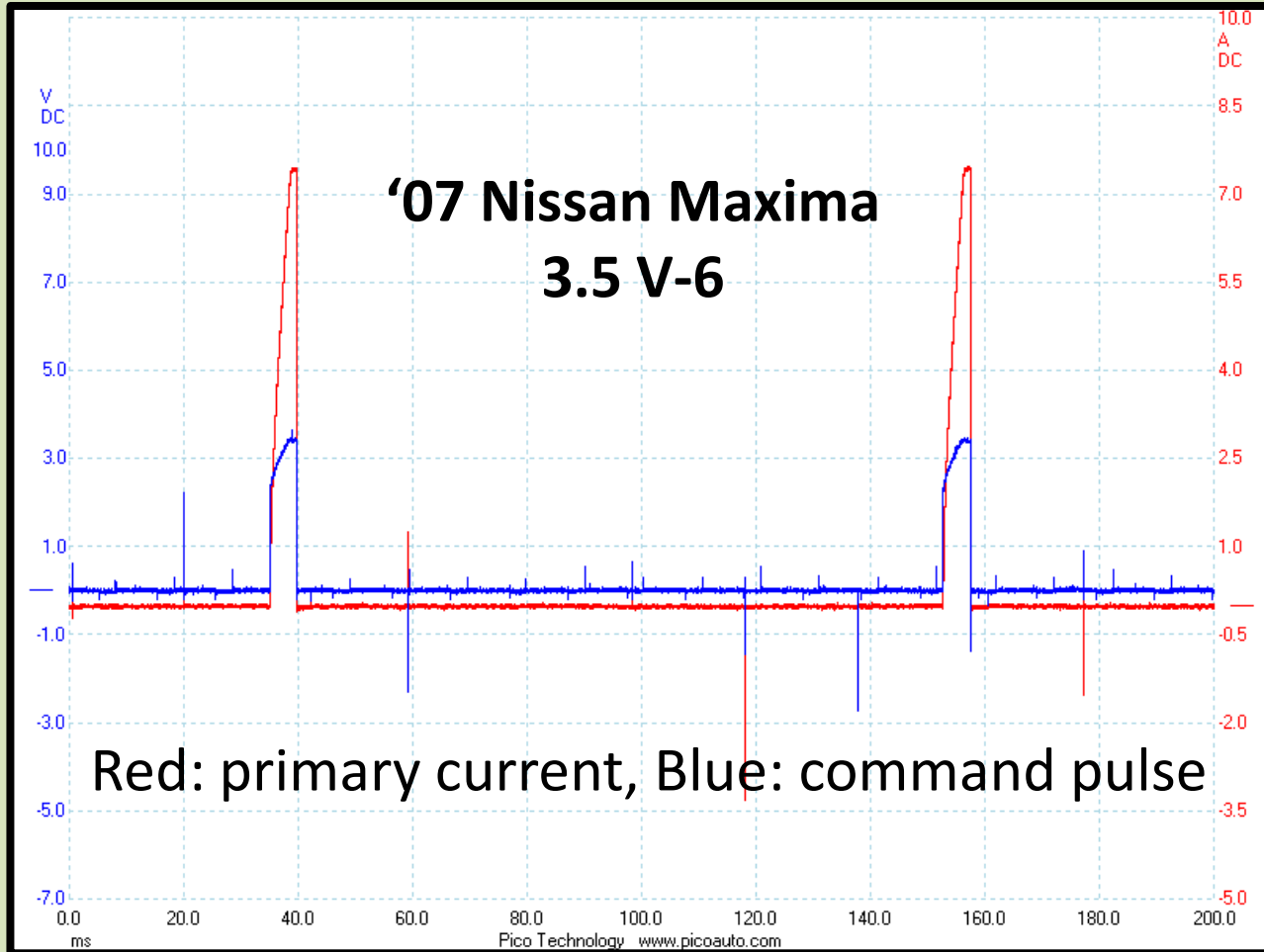
# 3 wire coils: PCM command pulse



# 3 wire coils: PCM command pulse

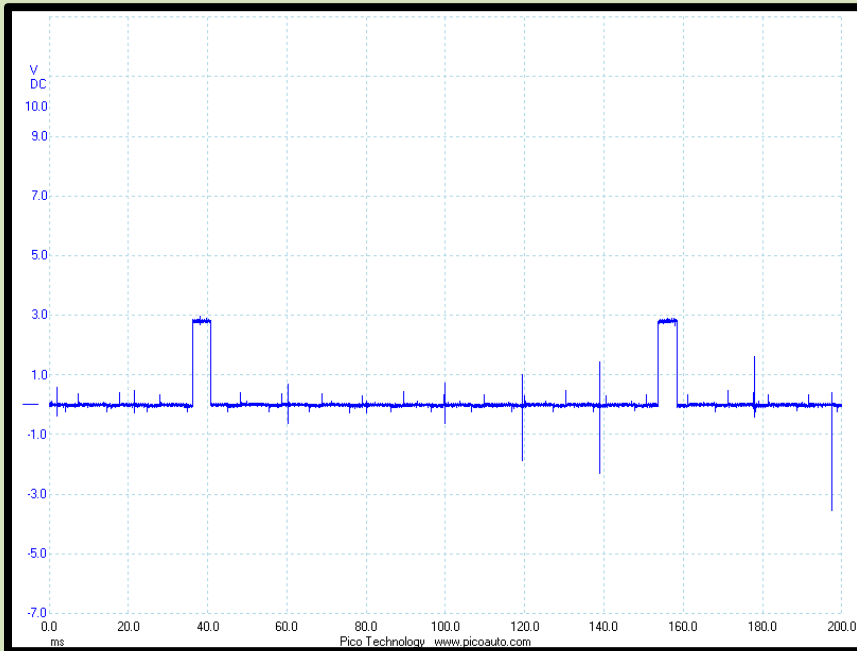


# 3 wire coils: PCM command pulse

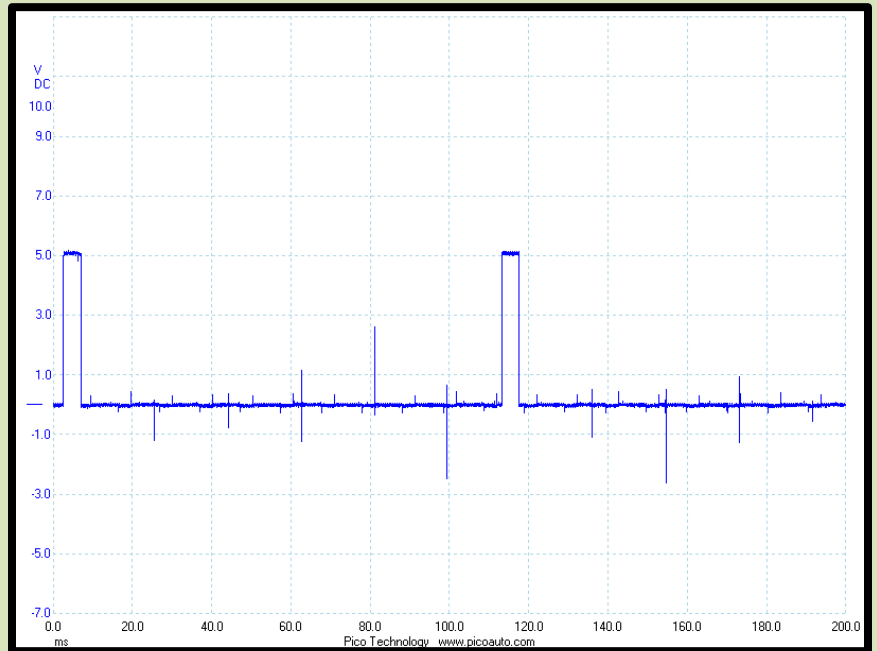


# 3 wire coils: PCM command pulse

Pulse with coil plugged in  
“normal”



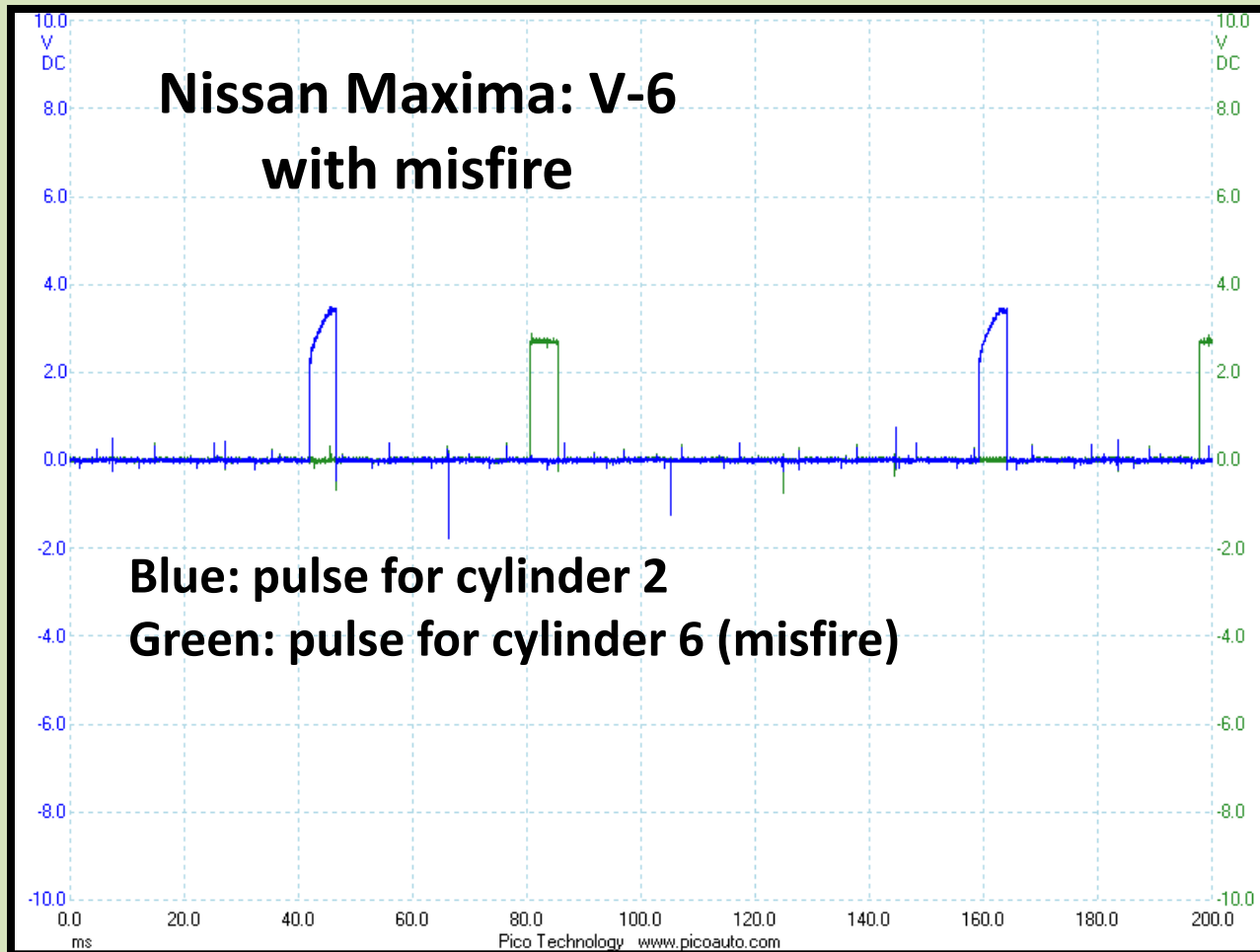
Pulse with coil unplugged:  
full 5 v



**Despite difference, PCM does not set DTC's  
with coil unplugged!**

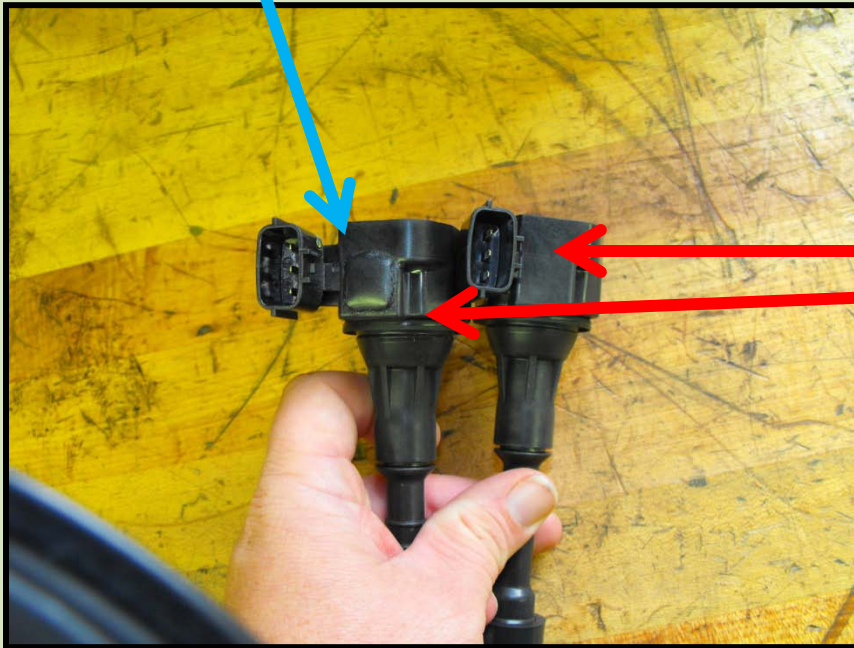


# 3 wire coils: PCM command pulse



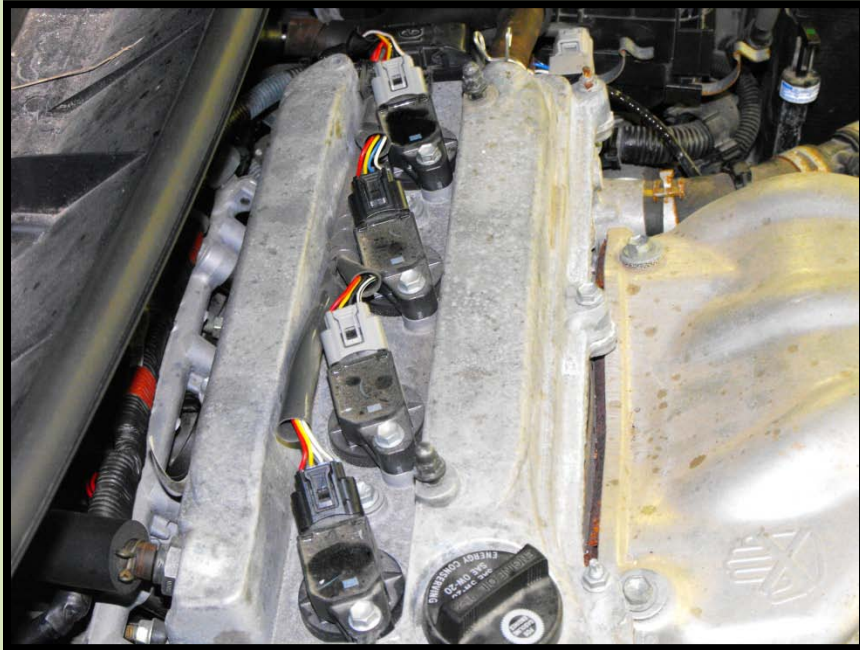
# 3 wire coils: PCM command pulse

Faulty coil identified

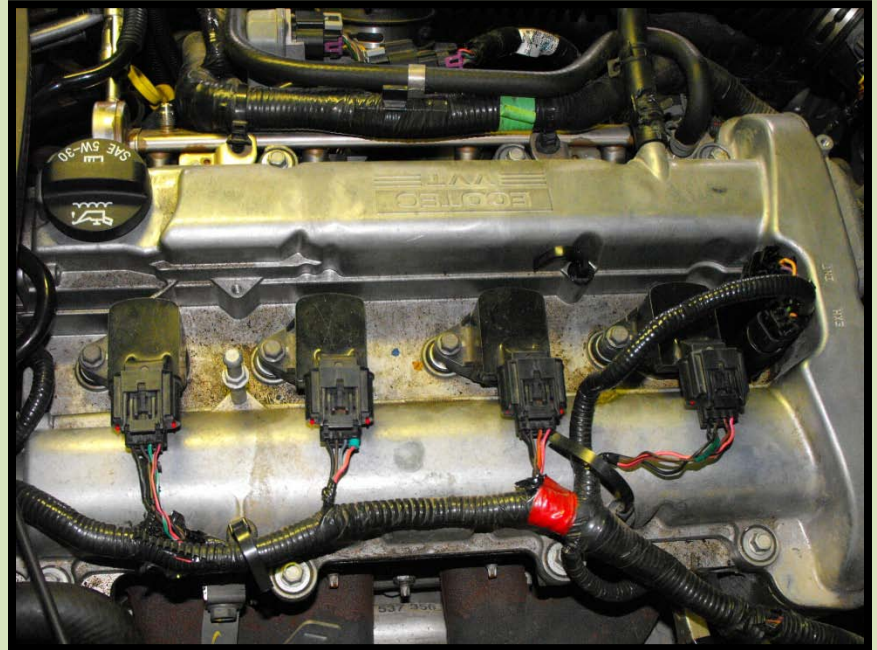


2 coils from Maxima V-6  
coil on left fried

# 4 wire coils



**Toyota's version**

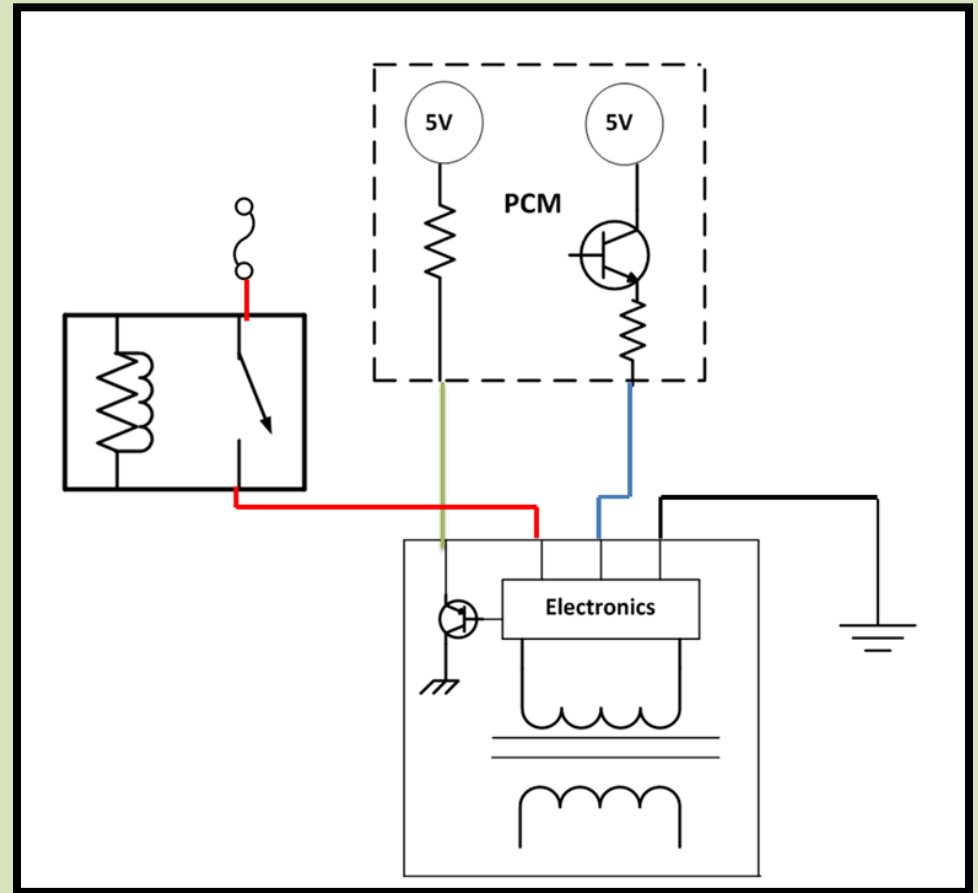


**GM's version**

# 4 wire coil: Toyota version

The 4 wires are:

1. 12 volt power
2. Chassis Ground
3. PCM Command Pulse
4. "IGF" diagnostic pulse



# 4 wire coil: Toyota version

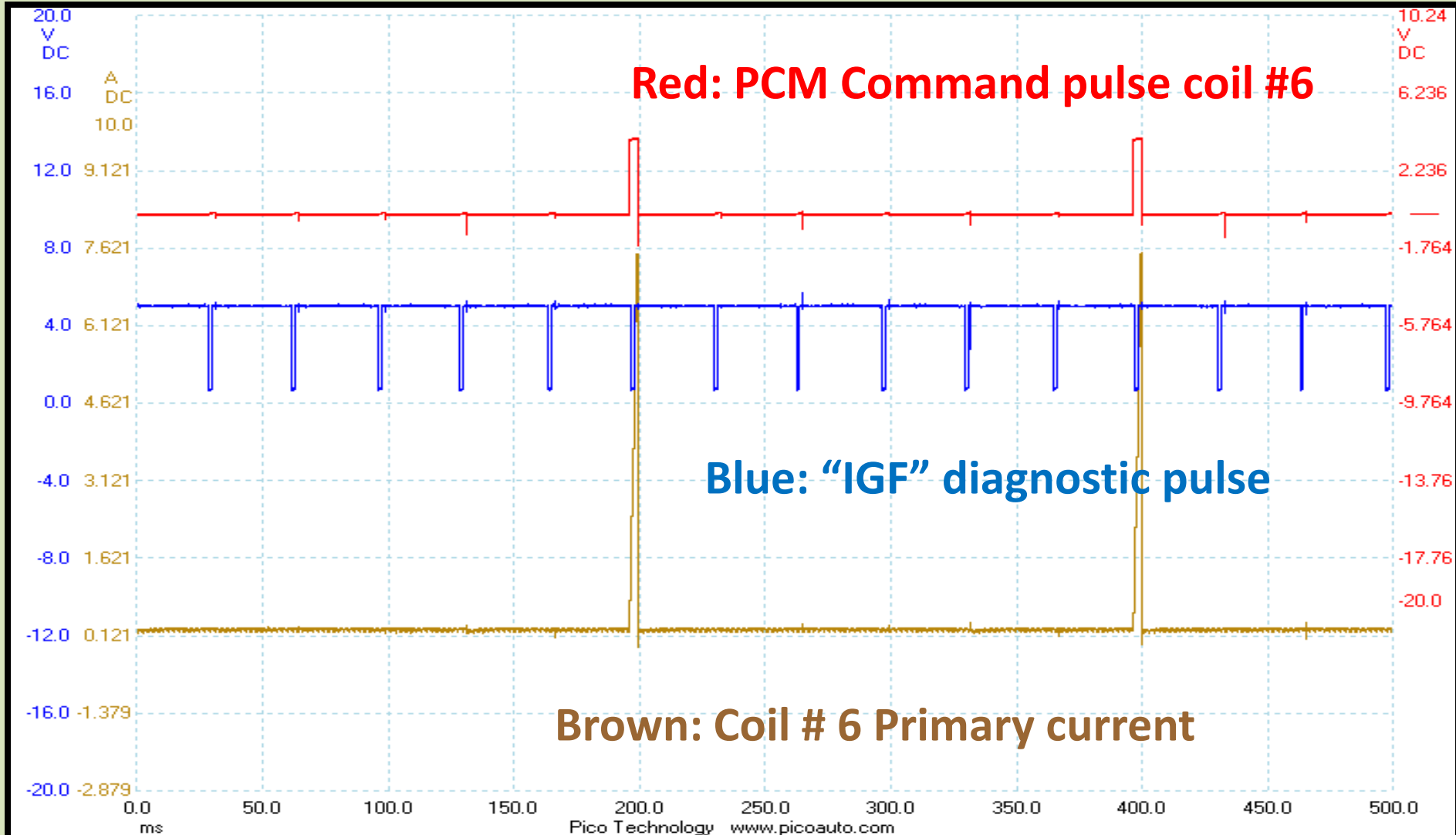
The PCM provides a 5 volt bias on “IGF”

“IGF” is run in parallel to all coils

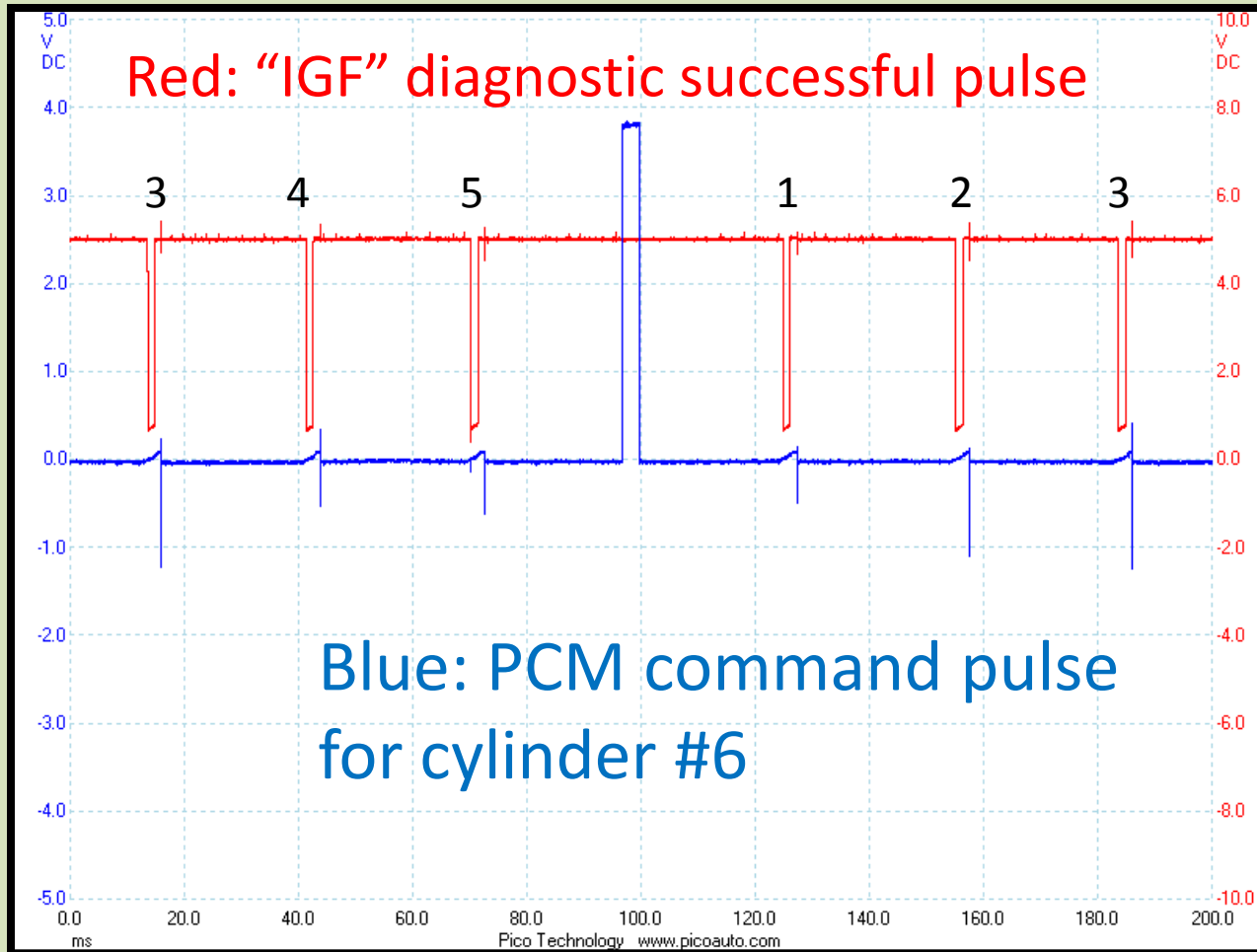
Internal electronics in the coil monitor the firing

Coil electronics pulse “IGF” to ground when  
successful

# 4 wire coil: Toyota version



# 4 wire coil: Toyota version



Chassis ground **disconnected** from coil #6: missing "IGF" pulse

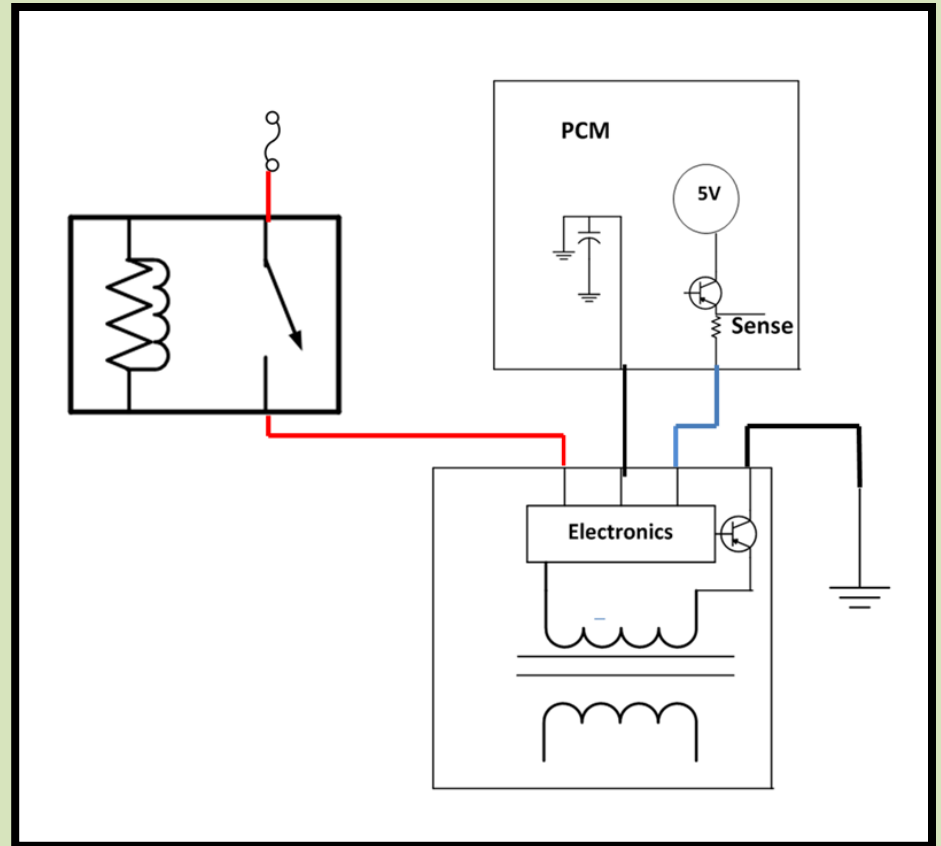




# 4 wire coil: GM version

The 4 wires are:

1. 12 volt power
2. Chassis ground
3. PCM command pulse known as "IC" or ignition command
4. Low reference



# 4 wire coil: GM version

## Grounds

The coil hold down bolt eyelet electrically connects to the chassis ground circuit pin

Normally eyelet does not connect to low reference circuit but it can in failsafe mode

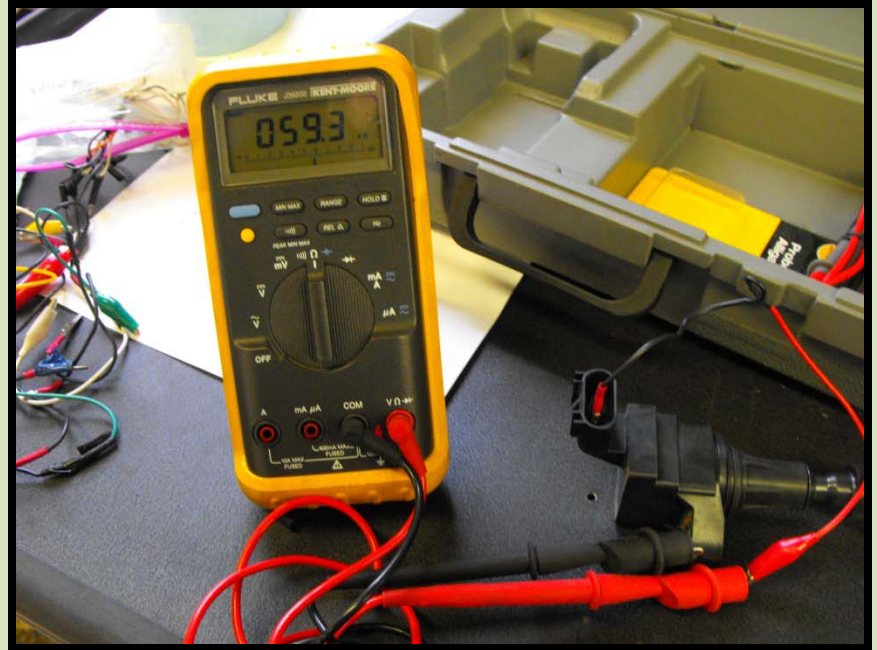


**Low reference terminal to chassis ground terminal**  
**59.5 K  $\Omega$**

# 4 wire coil: GM version



**Chassis ground terminal  
to bolt eyelet .1 Ω**



**Low Reference terminal to  
bolt eyelet 59.3 KΩ**

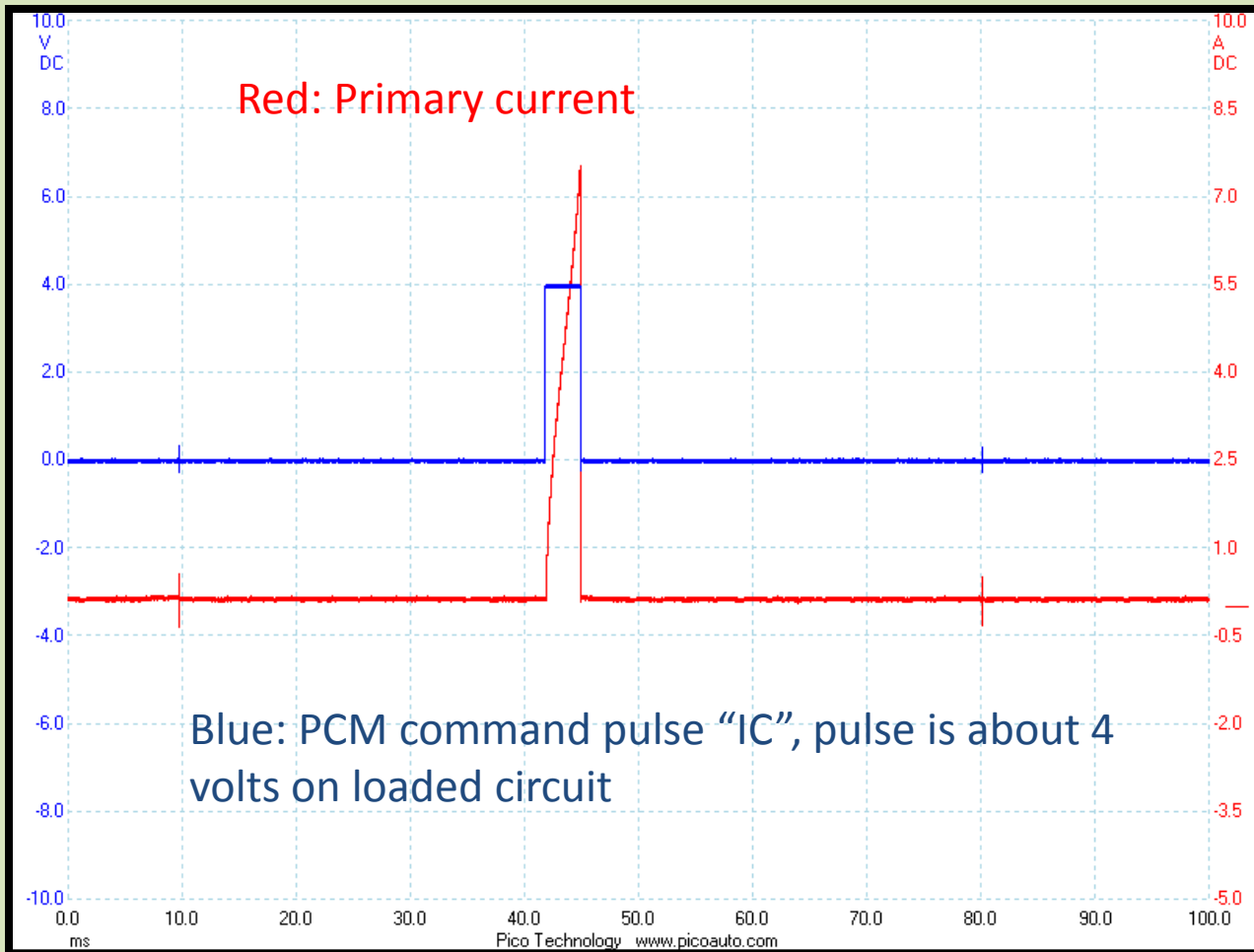
# 4 wire coil: GM version

**Low reference** is a ground circuit but it is sourced through the PCM.

The PCM treats it to provide a “clean ground”

Normally low reference provides a ground for the electronics in the coil and the coil windings as a load device utilize chassis ground

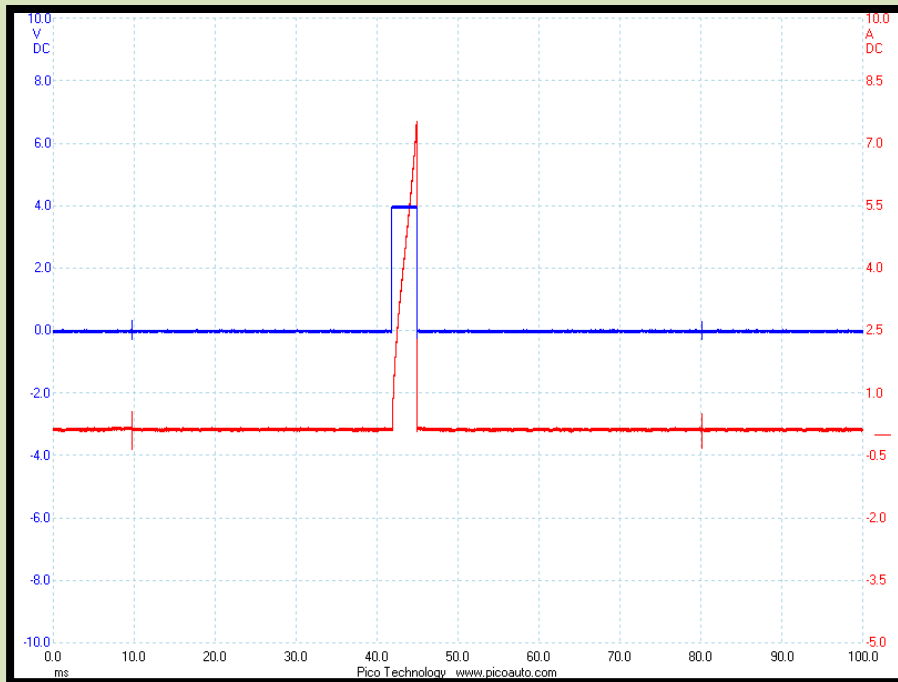
# 4 wire coil: GM version



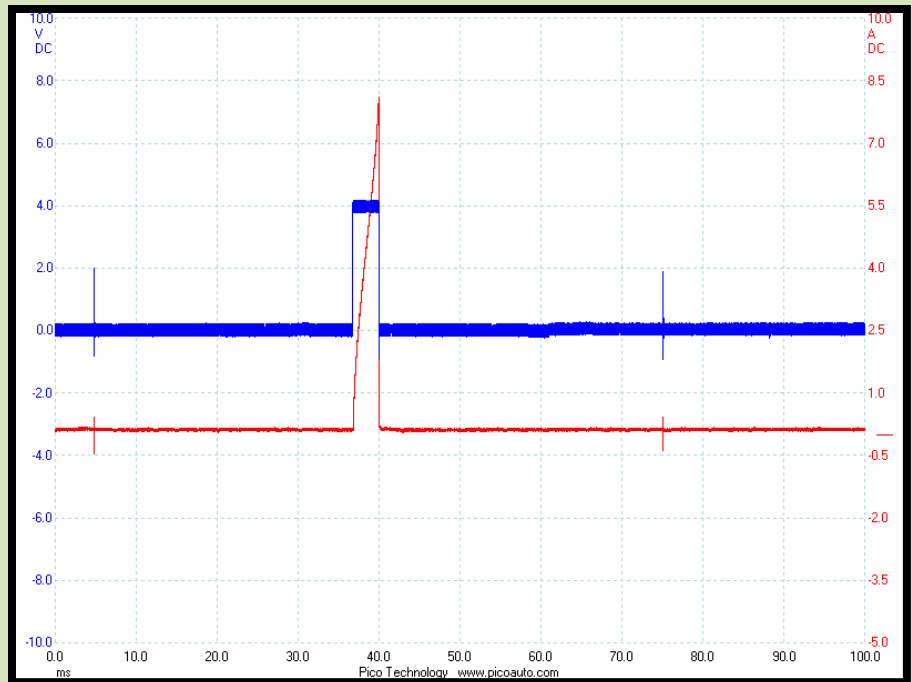
2007 Pontiac Solstice 2.4L

# 4 wire coil: GM version

2007 Pontiac Solstice 2.4L



“normal”: IC pulse is  
a clean line



Low reference  
removed: IC gets fuzzy

# 4 wire coil: GM version

## Experiment on Solstice:

1. Remove only low reference: runs fine
2. Remove only chassis ground: runs fine
3. Remove both chassis ground and low reference: runs fine

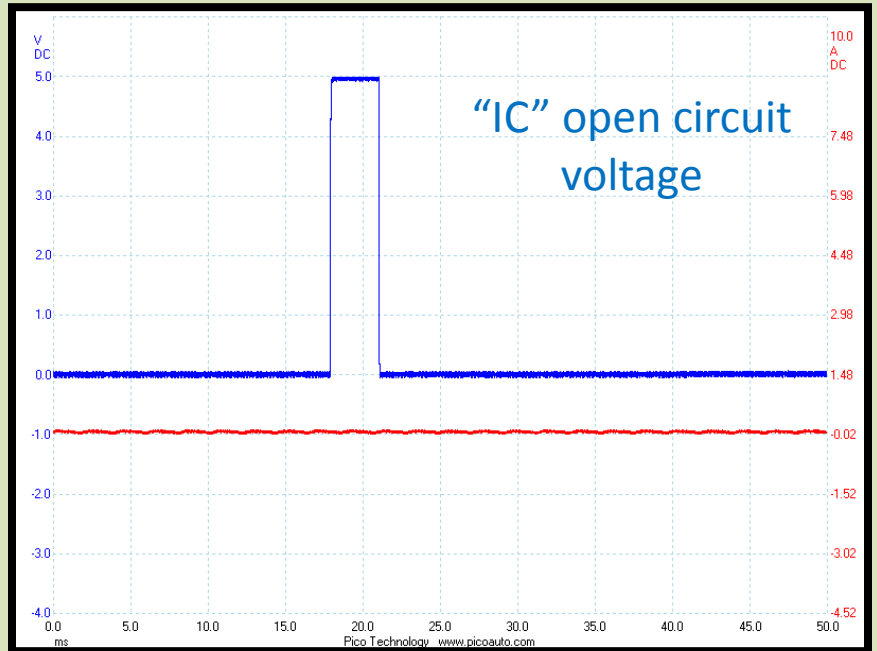
Indicating ability to ground coil electronics through eyelet bolt ground if necessary

# 4 wire coil: GM version

“IC” is monitored

If IC is open or shorted, a DTC is triggered

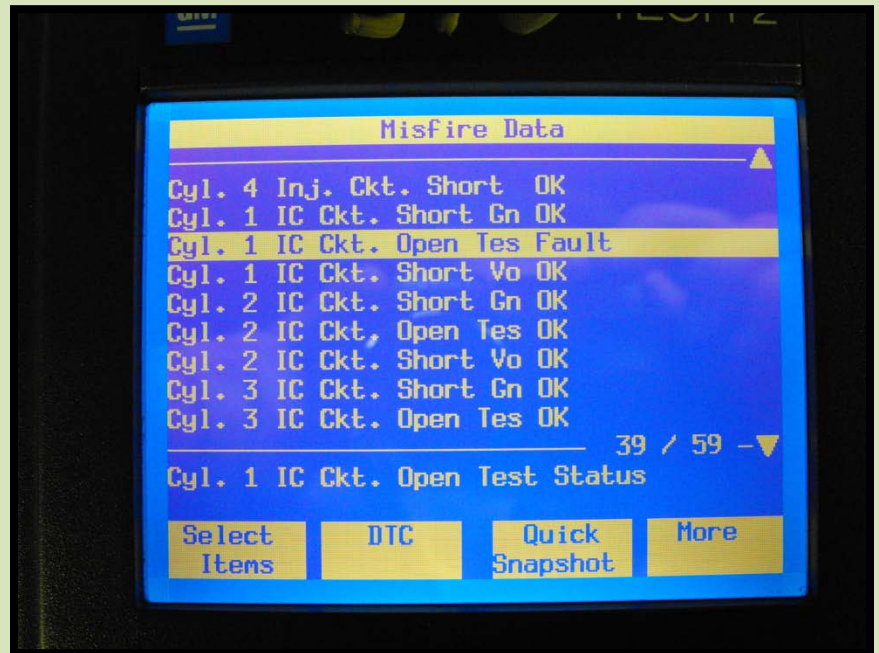
“unloaded” IC pulse is 5 volts but is about 4 volts when connected





# 4 wire coil: GM version

The type of fault can be viewed on the Tech 2 scantool “open or short” and identified by cylinder



# Summary

2,3 and 4 wire coil versions are different in control & monitoring strategies

**Primary current** is an available test on all types: cylinder to cylinder variations are valuable

Different methods exist to check for “spark”

# Practical when access is not an issue



# Summary

No start/spark or dead hole:

What is easiest to access on the vehicle?

- PCM
- Coil(s)
- Common relay or ignition fuse

# Summary

## 2 wire coils:

**Scope/ amp clamp:** primary current at common fuse/relay

**Scope:** primary voltage patterns, easiest at PCM?

**DVOM:** verify voltage at coils, coil primary/secondary resistance

**Scope:** secondary voltage if feasible

**Scan Tool:** PCM will detect coil DTC's, possibly more

# Summary

## 3 wire coils:

**Scope/ amp clamp:** primary current at common fuse/relay

**Scope:** command pulse voltage compare cylinder to cylinder, check loaded vs unloaded

**DVOM:** only good for power/ground checks at coil

**Scope:** secondary voltage if feasible

**Scan tool:** probably not helpful

# Summary

## 4 wire coil: Toyota

**Scope/ amp clamp:** primary current at common fuse/relay

**Scope:** PCM command pulse and “IGF” voltage

**DVOM:** power & ground at coils, 5v on “IGF”

**Scope:** secondary voltage if feasible

**Scan Tool:** PCM will detect DTC's

# Summary

## 4 wire coil: GM

**Scope/ amp clamp:** primary current at common fuse/relay

**Scope:** IC command pulse voltage

**DVOM:** verify power, ground, low reference at coil

**Scope:** secondary voltage if feasible

**Scan Tool:** Monitor for IC fault, Coil DTC's



# Presentation Conclusion

Questions? Comments

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Presentation available on open SIU: Google  
“open SIU”