How do Ignition Coils Work?

Read
http://www.linnbenton.edu/auto/perform/ignition.html
and
http://www.linnbenton.edu/auto/perform/how_spark.html
View animation at
http://gillinstruments.com/products/digital_ignition/introduction/graphics/Ignition_Coil.swf
(above link works in Chrome and Firefox. May not work in Explorer)

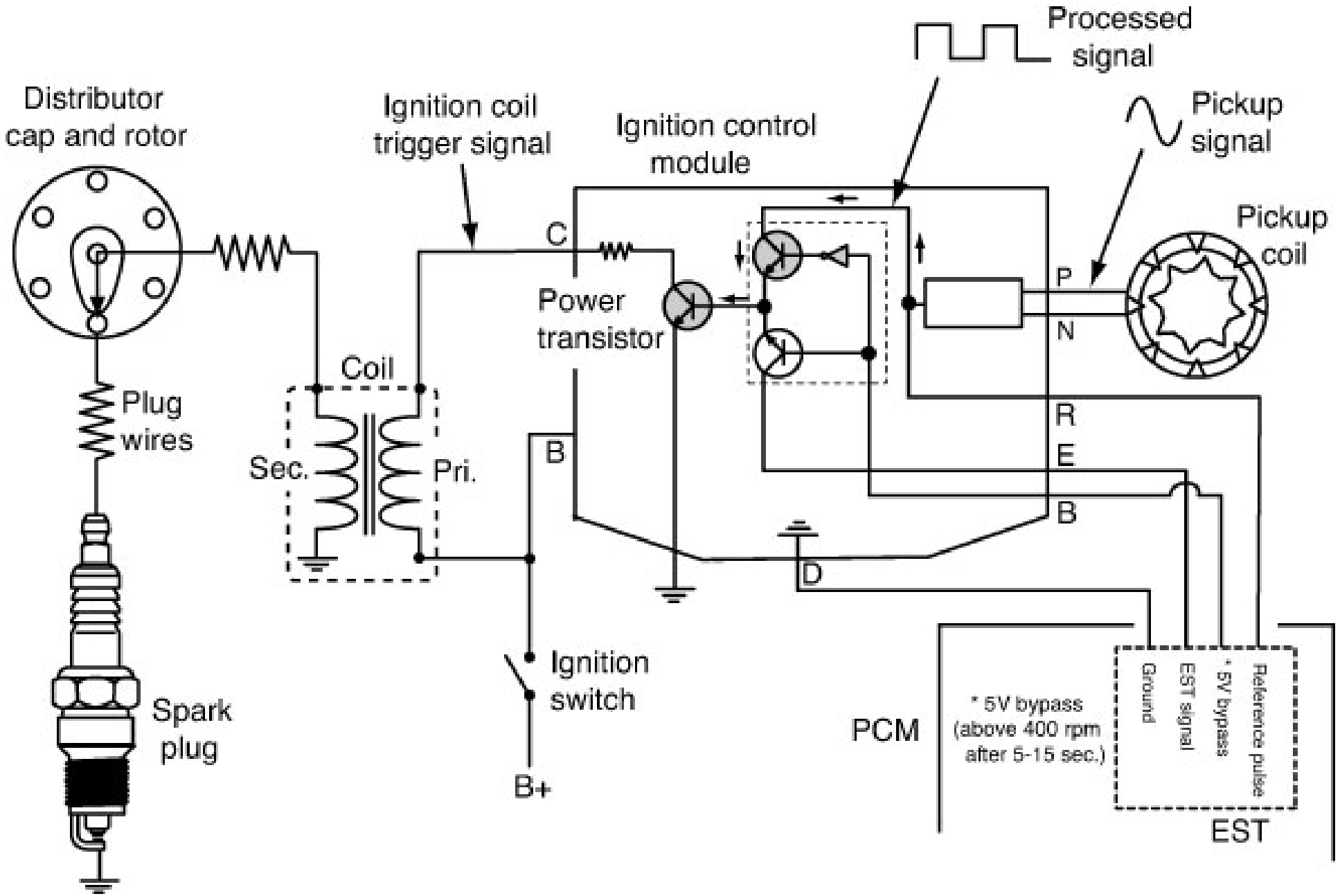
What happens if the coil wire is unplugged?

Any open circuit in the secondary spark plug current path will create a VERY high voltage in the secondary coil.

This can short out (burn through) the secondary winding insulation causing the coil to work at reduced power (misfire under load)

It is possible for high voltage to burn through insulation of primary windings causing a voltage spike to burn out the Power Transistor

If this happens the vehicle will not run until the ignition control module is replaced.


Processed signal
Distributor cap and rotor
Ignition coil trigger signal
Ignition control module
Pickup signal
Pickup coil
C
Power transistor
P
N
Coil
Plug wires
Sec.
Pri.
B
R
E
B
D
Ignition switch
Spark plug
B+
PCM
* 5V bypass (above 400 rpm after 5-15 sec.)
Ground
EST signal
* 5V bypass
Reference pulse
EST

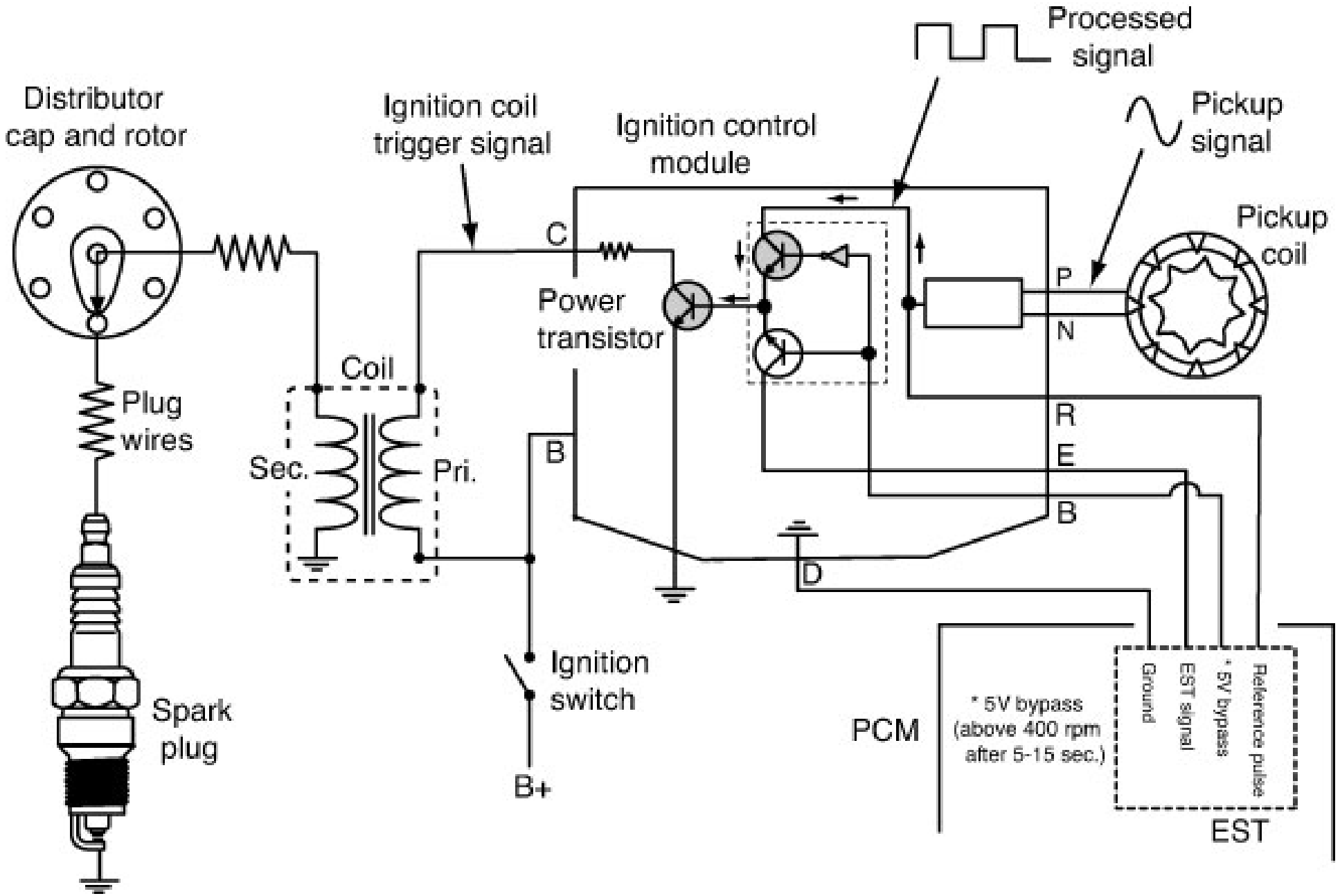
Always use Extreme Care when cranking engine with any spark plug wire removed!

You will do this when compression testing.

You can easily damage or destroy an ignition coil and/or ignition control module if the coil makes spark when there is an open circuit.

What if you have No Spark?

- Figure out where the problem is!
- Cut the system in half to eliminate components.
- The ignition coil is best place to decide if the problem is in the primary or secondary


Processed signal
Distributor cap and rotor
Ignition coil trigger signal
Ignition control module
Pickup signal
Pickup coil
C
Power transistor
P
N
Coil
Plug wires
Sec.
Pri.
B
R
E
B
D
Ignition switch
Spark plug
B+
PCM
* 5V bypass (above 400 rpm after 5-15 sec.)
Ground
EST signal
* 5V bypass
Reference pulse
EST

How do you check the Primary?

A 12 volt test light connected to battery Positive

and

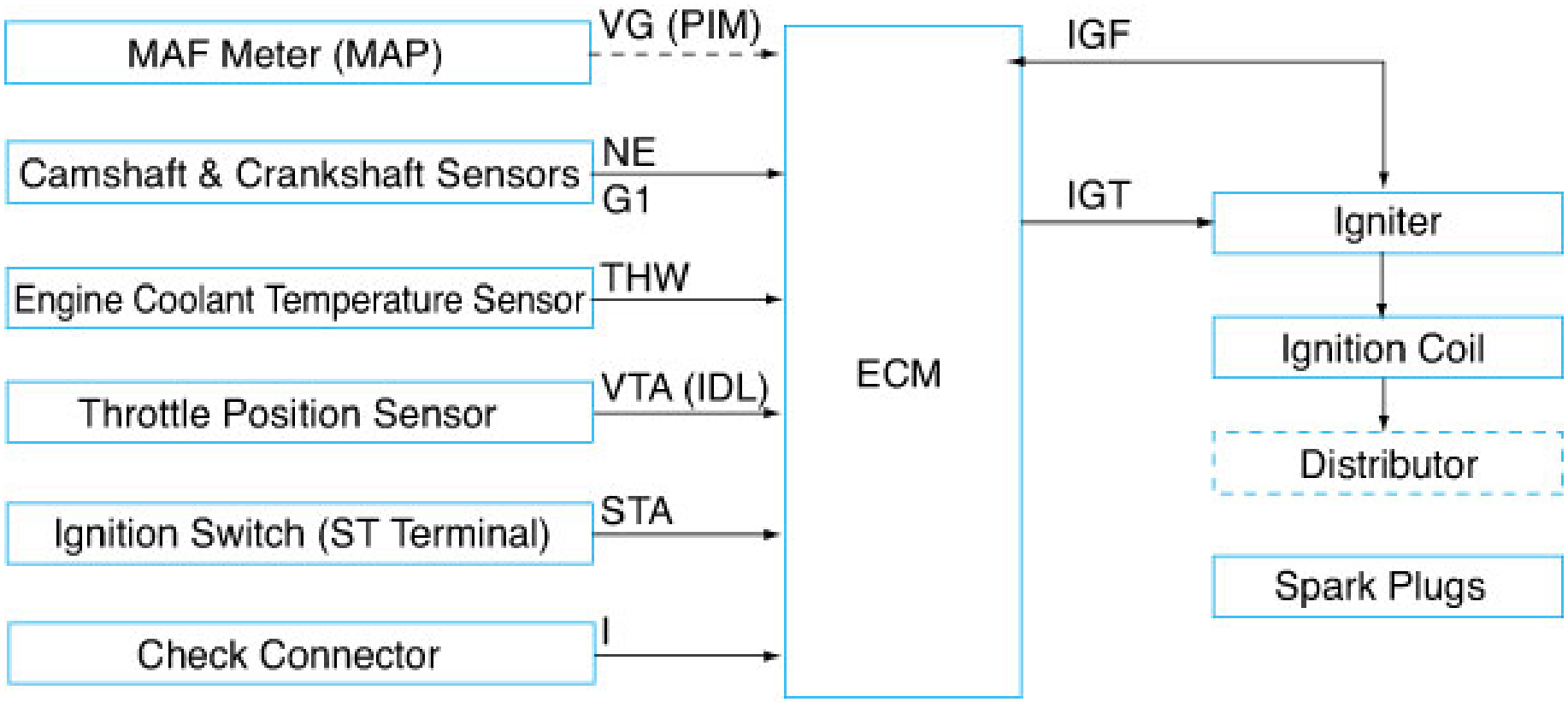
coil Negative will Flash ON/OFF while cranking.

No ON-OFF at test light means either no positive voltage to the coil, or the coil is not being turned ON and OFF at the power transistor

- If the coil has Positive voltage but is not being switched ON/OFF check the sensors that trigger the Ignition control module.

- Scan tool is best to see if crank, or cam signals are being received.

- Systems use different controls, use service information for diagnosis



Ignition Systems

How do you check the Secondary?

Use an Ohm Meter to check coil winding resistance.

Open circuit means – bad coil

Slightly low resistance (check specifications) indicate a shorted coil.

Coils that measure proper ohm readings may not be good coils as insulation may hold for Ohm test but fail at high voltage

How do you check the Secondary?

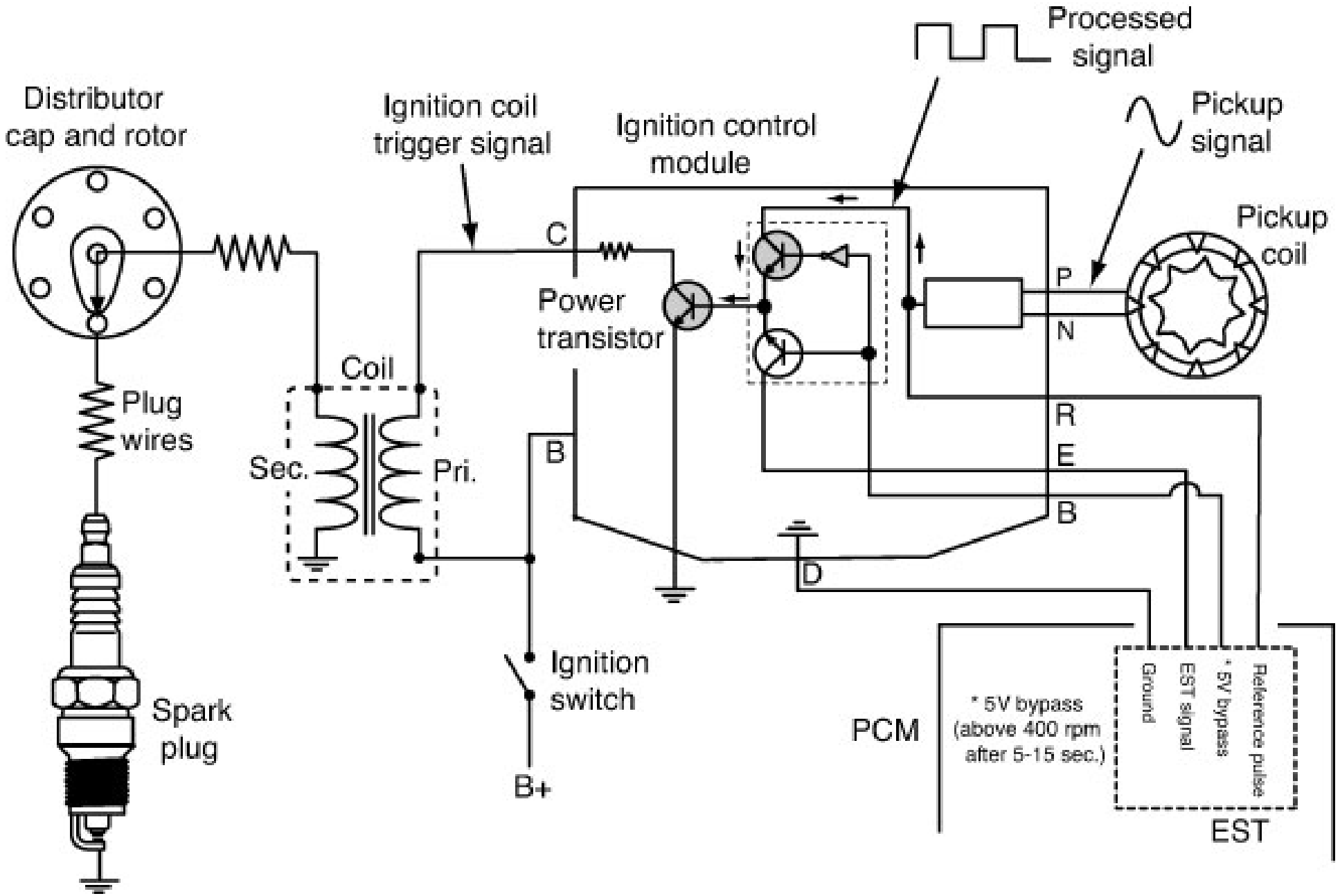
Do not neglect to test coil and plug wires with ohm meter

Do a thorough visual inspection to look for any carbon tracks or indication that the insulation has failed

What are the basic types of ignition systems?

Distributor Ignition (DI)

Will use one coil with a distributor cap and rotor to send spark to each cylinder


Processed signal
Distributor cap and rotor
Ignition coil trigger signal
Ignition control module
Pickup signal
Pickup coil
C
Power transistor
P
N
Coil
Plug wires
Sec.
Pri.
B
R
E
B
D
Ignition switch
Spark plug
B+
PCM
* 5V bypass (above 400 rpm after 5-15 sec.)
Ground
EST signal
* 5V bypass
Reference pulse
EST

What are the basic types of ignition systems?

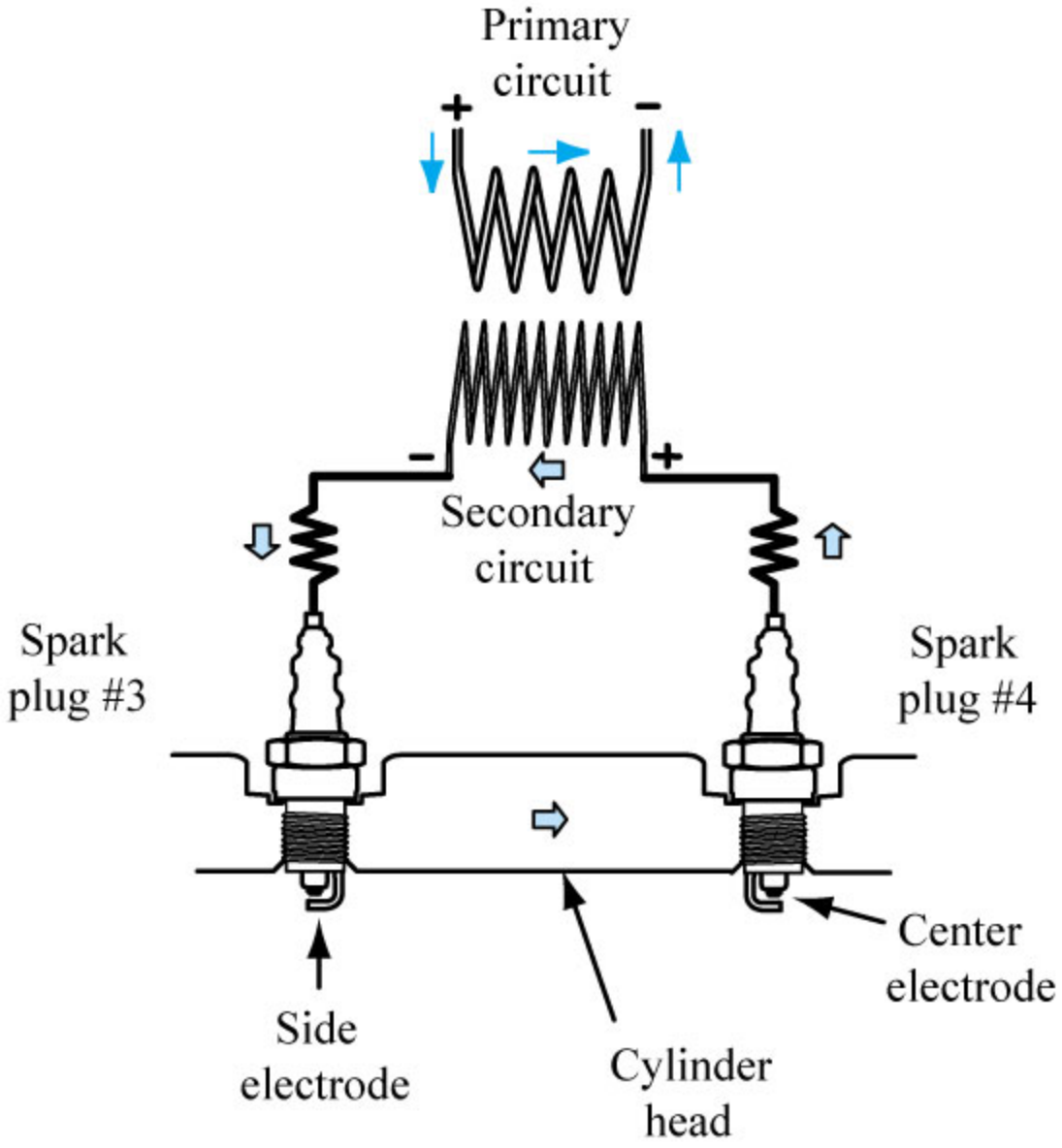
Distributor Ignition (DI)

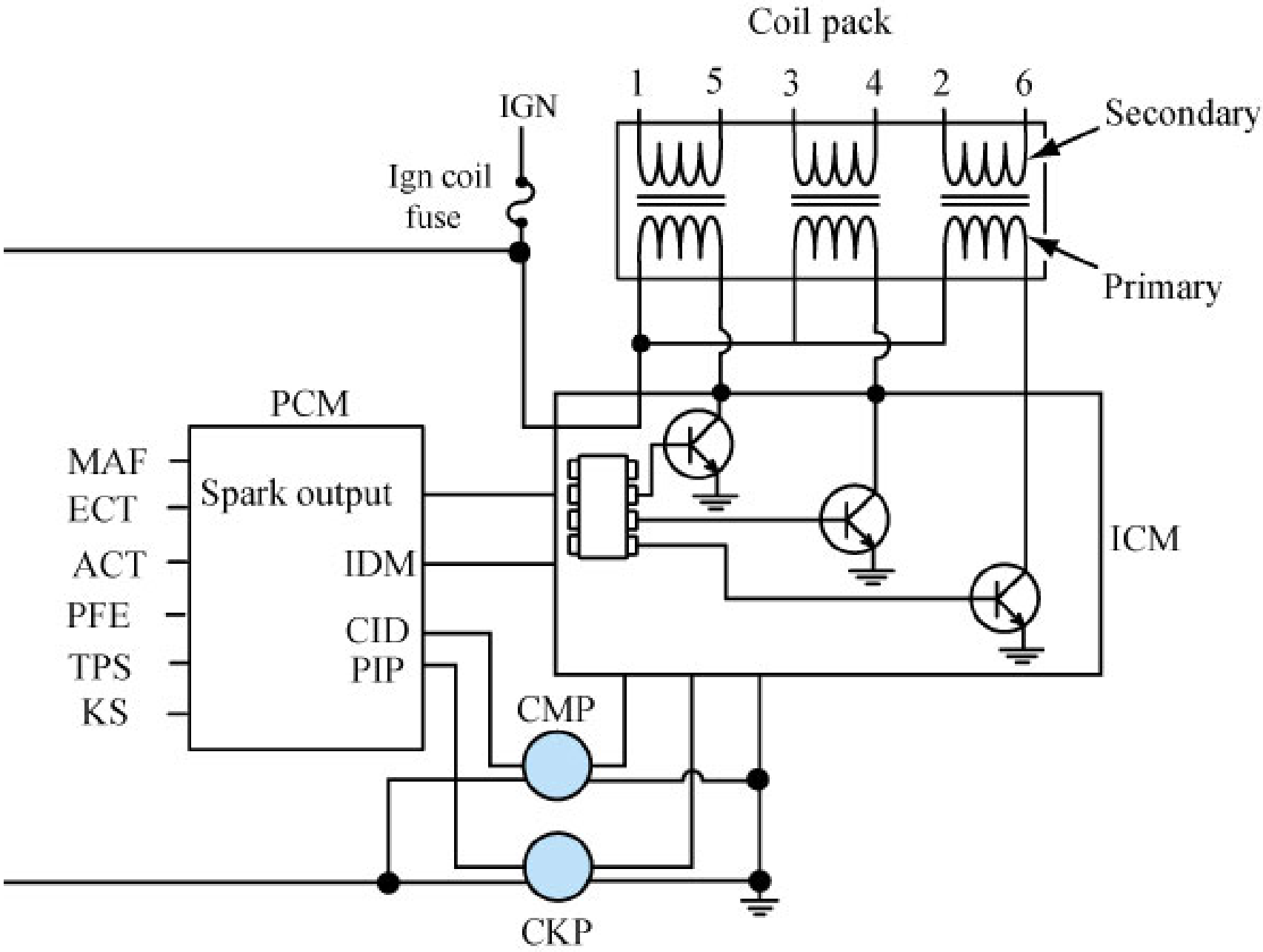
Distributor Less Ignition System (DIS)
also called Electronic Ignition (EI)
and Wasted Spark Ignition

Will use one coil for every pair of cylinders.

Fires spark plug on compression AND exhaust stroke

When it fires on exhaust the spark is “Wasted”


Primary
circuit
+
–
Secondary
circuit
–
+
Spark
plug #3
Spark
plug #4
Center
electrode
Side
electrode
Cylinder
head


Coil pack
1
5
3
4
2
6
IGN
Secondary
Ign coil
fuse
Primary
PCM
MAF
ECT
ACT
PFE
TPS
KS
Spark output
IDM
CID
PIP
ICM
CMP
CKP

What are the basic types of ignition systems?

Distributor Ignition (DI)
Wasted Spark Ignition (EI)

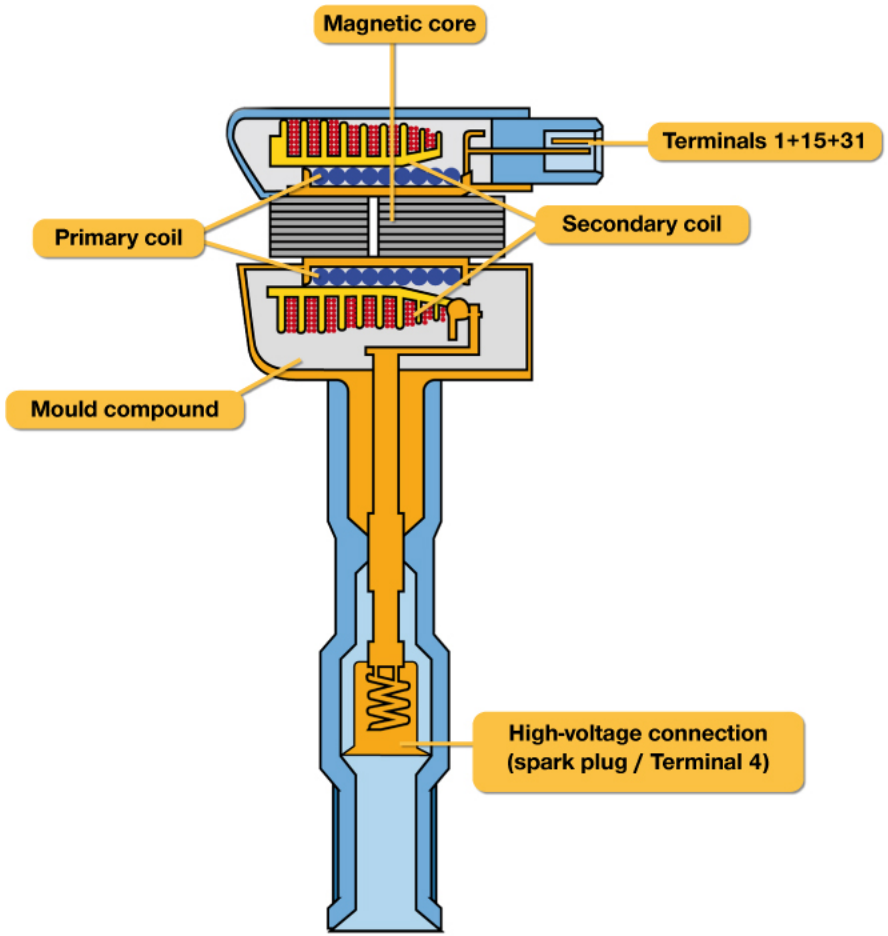
Distributor Less Ignition System (DIS)

also called Electronic Ignition (EI)

And Coil On Plug

Or Coil Near Plug

Will use one coil for each cylinders.


Magnetic core
Terminals 1+15+31
Primary coil
Secondary coil
Mould compound
High-voltage connection
(spark plug / Terminal 4)

What are the basic types of ignition systems?

Distributor Ignition (DI)

Wasted Spark Ignition (EI)

Coil On Plug (EI)

Coil Near Plug (EI)

A good article that explains these types of ignition

http://leakylugnut.com/electronics/ignition-systems/