

Fall 2012

Variable Camshaft Timing/ Variable Valve Timing

Matt Dixon

Southern Illinois University Carbondale, dixonm@siu.edu

Follow this and additional works at: http://opensiuc.lib.siu.edu/auto_pres
Presented at the Fall 2012 ICAIA Conference, Joliet Junior College, Joliet, IL.

Recommended Citation

Dixon, Matt, "Variable Camshaft Timing/ Variable Valve Timing" (2012). *Presentations*. Paper 29.
http://opensiuc.lib.siu.edu/auto_pres/29

This Article is brought to you for free and open access by the Department of Automotive Technology at OpenSIUC. It has been accepted for inclusion in Presentations by an authorized administrator of OpenSIUC. For more information, please contact opensiuc@lib.siu.edu.

Variable Camshaft/Valve Timing

Presented by Matt Dixon,
SIUC Automotive Technology

ICAIA Conference fall 2012 at
Joliet Junior College

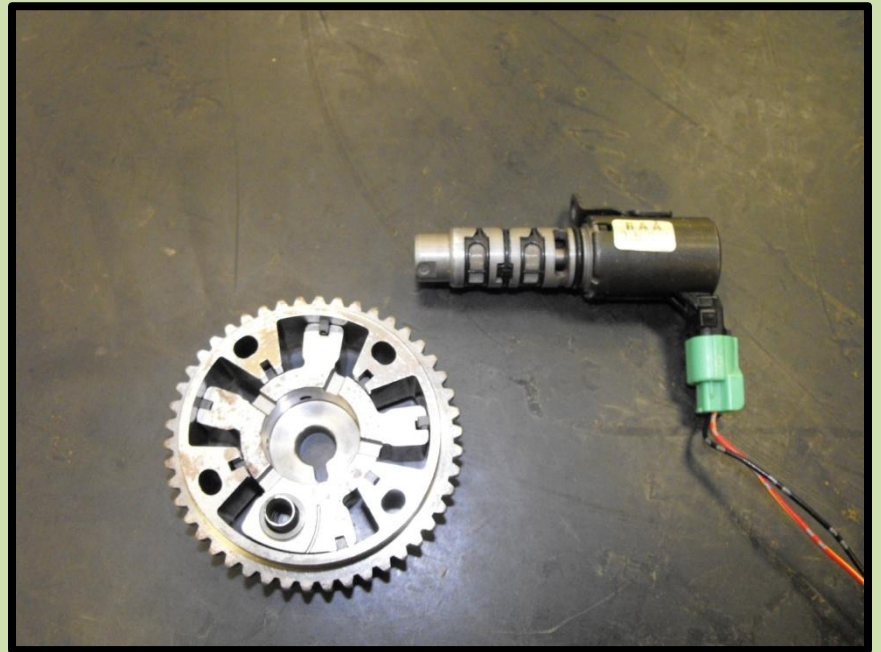
Phaser & Lobe switching styles



Phaser Variable Timing

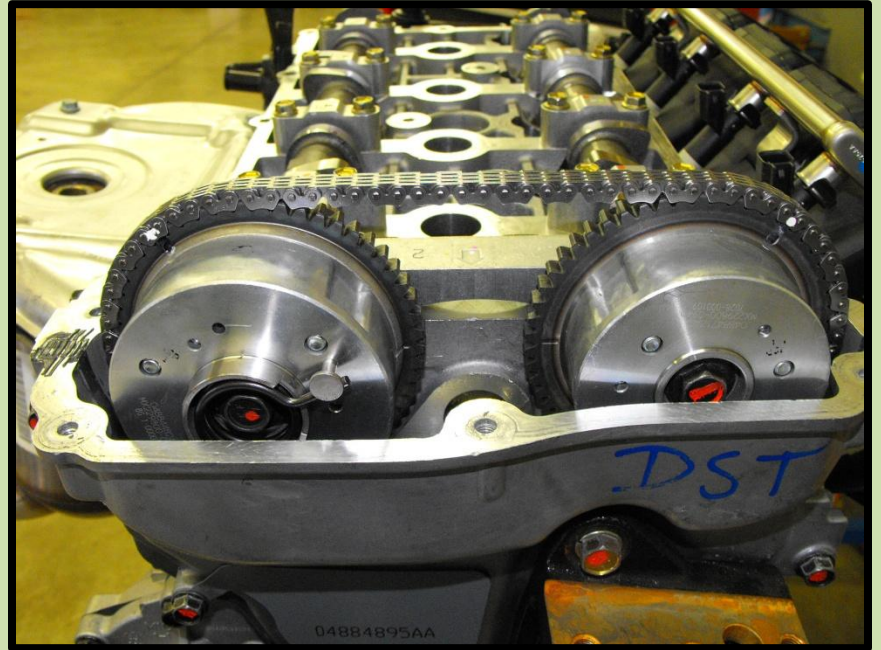
Changes in cam timing alter lobe centerlines & lobe separation angles to:

- **Reduce emissions**
- **Improve torque/power**
- **Increase efficiency**
- **Eliminate EGR valve**



Phaser Style: topics

- Mechanical
- Hydraulic
- Electrical
- Control Strategy
- Malfunctions + troubleshooting

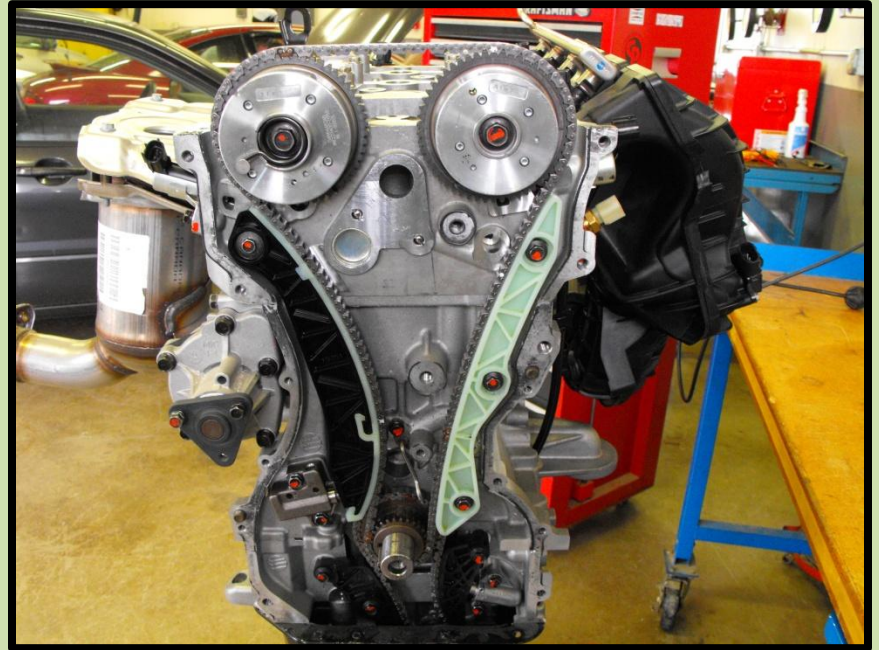


Phaser Style: Mechanical

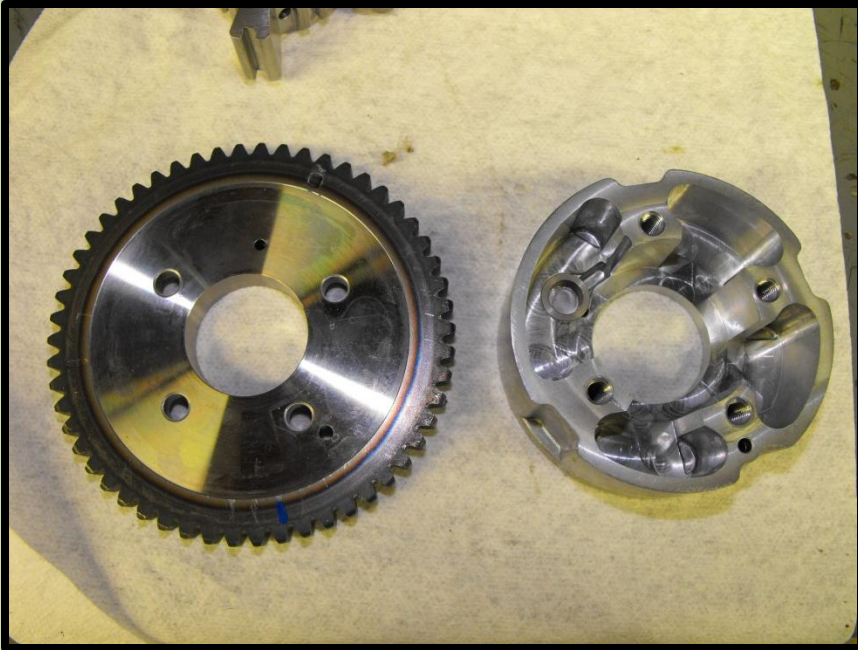
- Most manufacturers use a **phaser** on the front of the camshaft(s).
- Vaned rotor connects to cam, outer body connects to chain driven sprocket
- Typical default: **Exhaust full advance**
Intake full retard

Phaser Style: Mechanical

- Timing chain drives the camshaft sprockets
- The exhaust cam is on the left, intake cam on the right
- Clockwise rotation from the front view



Phaser Style: Mechanical



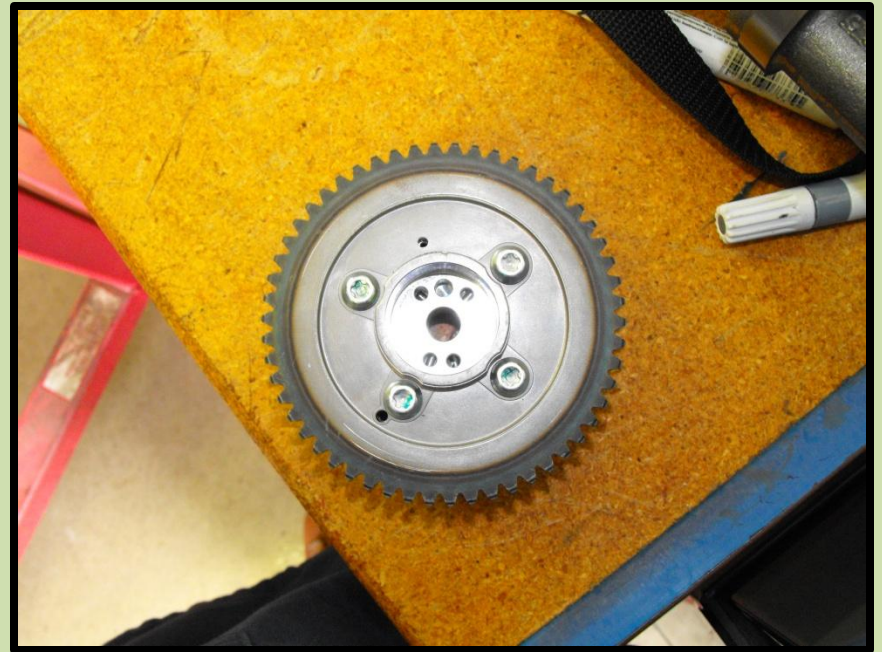
**Sprocket and
Phaser body**



Rotor

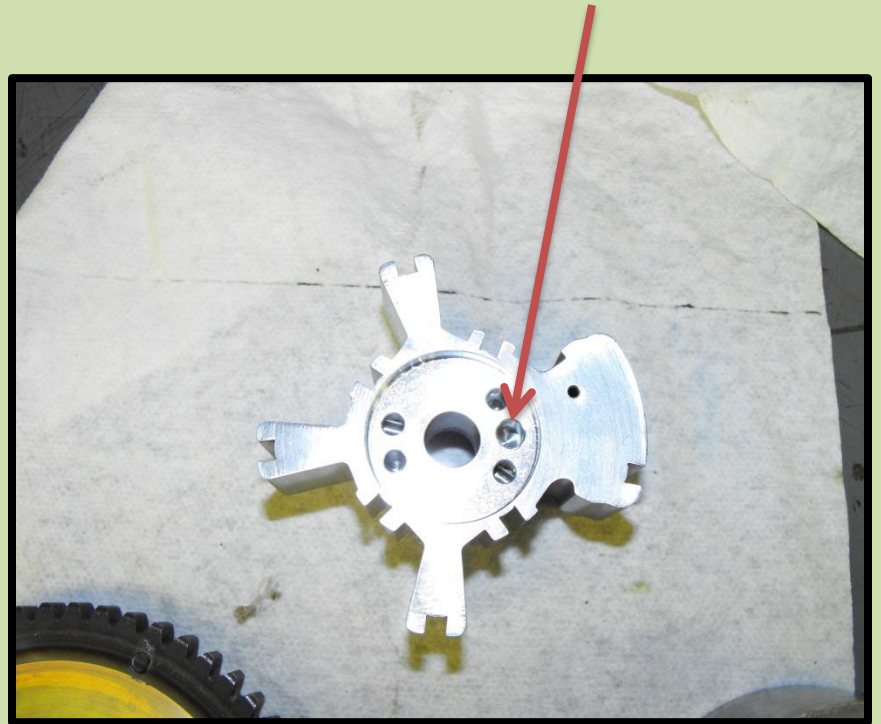
Phaser Style: Mechanical

- Chain driven sprocket is bolted to the phaser body using 4 five star fasteners



Phaser Style: Mechanical

- Rotor is the phaser portion that moves independently
- Dowel pin on the camshaft nose fits into the rotor
- Rotor drives the camshaft



Phaser Style: Mechanical

- Camshaft dowel pin mates with rotor portion of phaser
- Notice the hollow camshaft



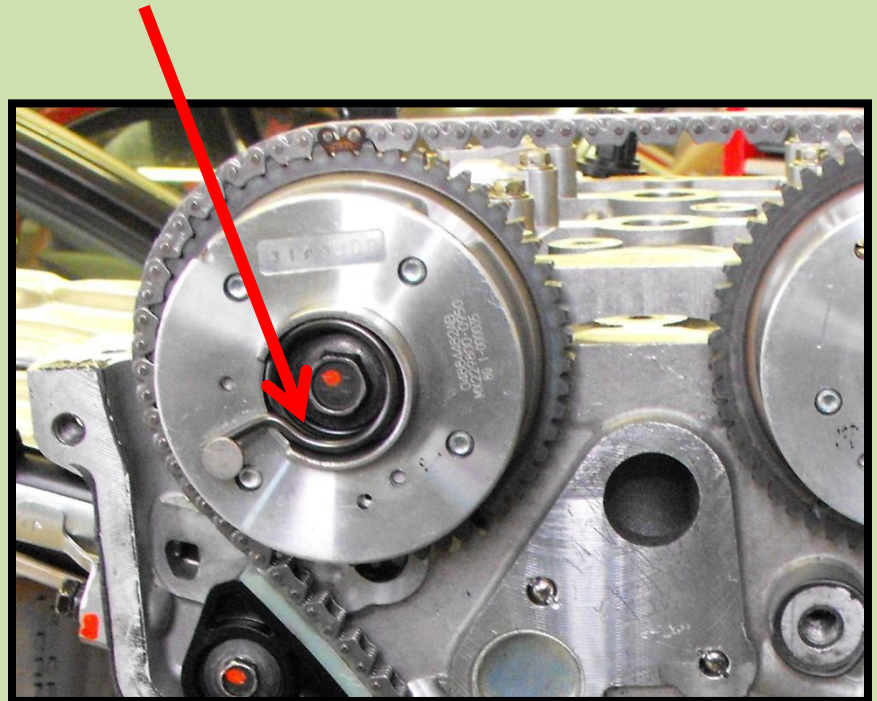
Phaser Style: Mechanical

- Oil pressure directed by **oil control valve**
- Oil is directed to chambers inside the phaser
- Depending on which side is pressurized or exhausted, rotor position is advanced or retarded



Phaser Style: Mechanical

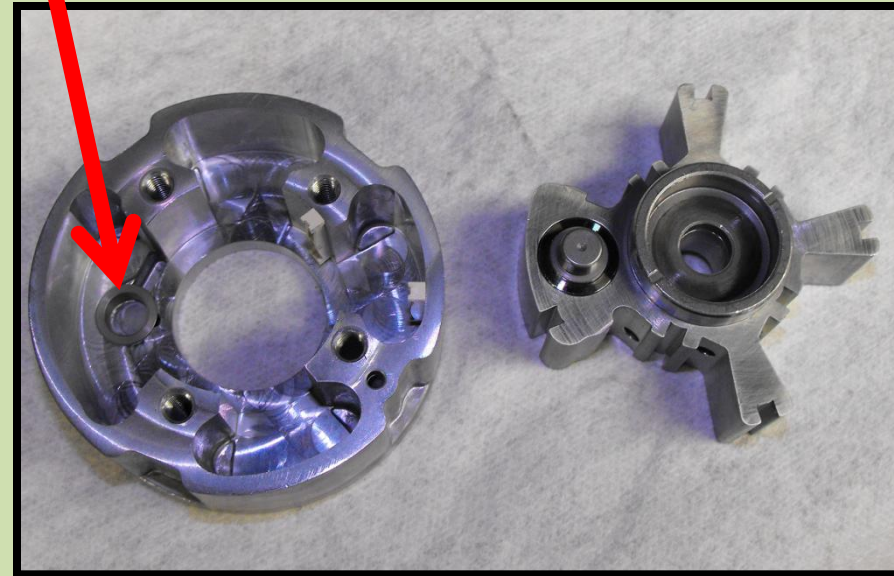
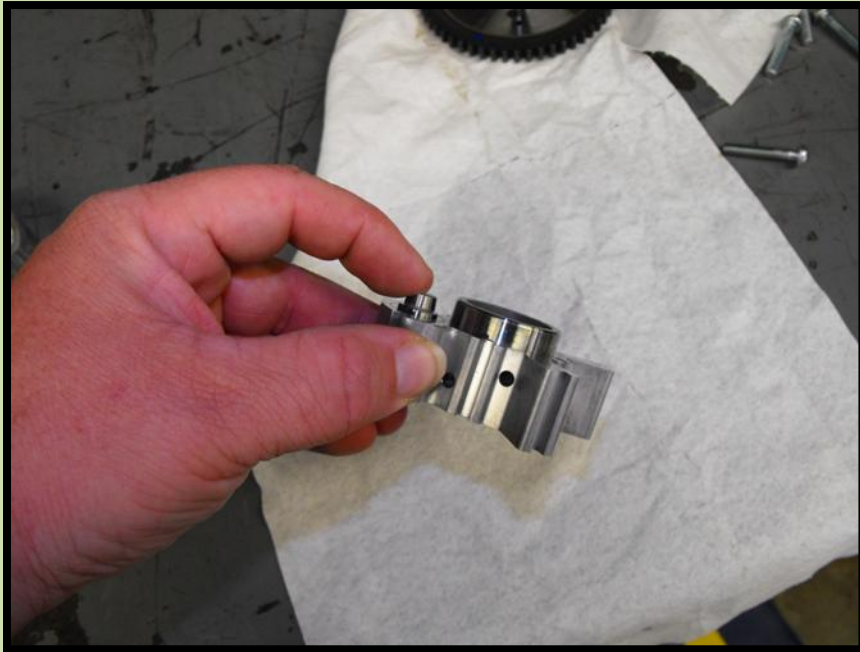
- Because the exhaust cam rests and lock in the fully advanced position, the rotor works against engine rotation
- The spring helps get the rotor to where the lock pin can engage



Phaser Style: Mechanical

To prevent noise & mechanical wear, a spring loaded lock pin is used

Pin locks in here w/o oil pressure



Phaser Style: Mechanical



Solenoid moves plunger about .115 inch

Phaser Style: Mechanical

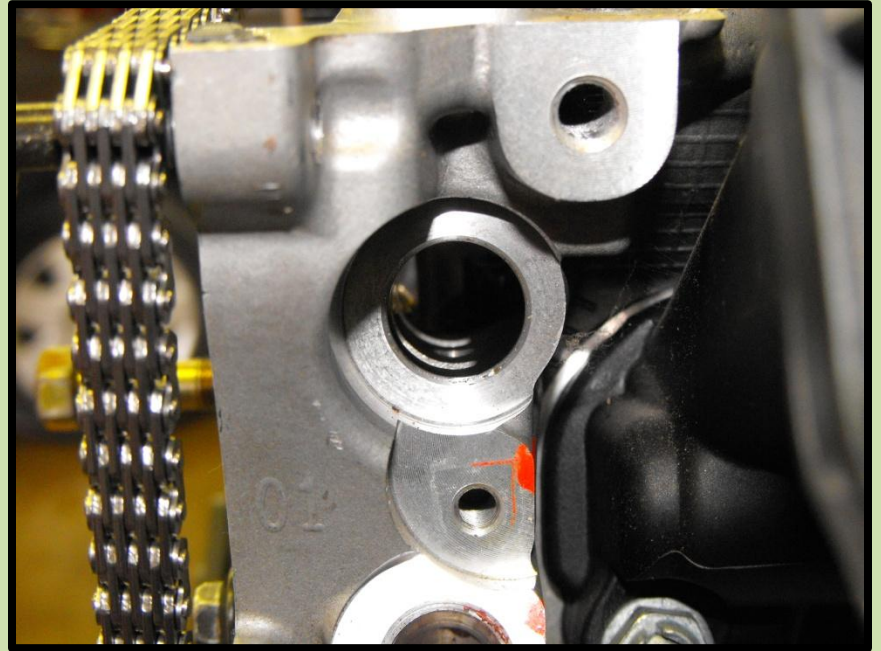


Solenoid activation and movement measure video clip

Phaser Style: Hydraulic

Pressurized oil moves through block galleys and passes through a **screen** on way to cylinder head

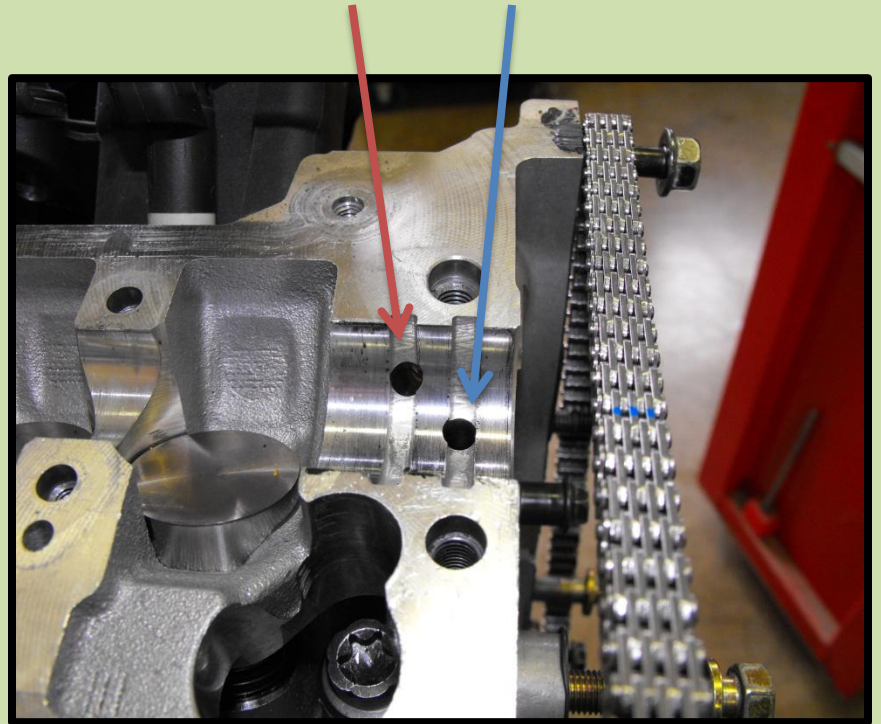
The pressure is directed by the oil control valve



O.C.V. port

Phaser Style: Hydraulic

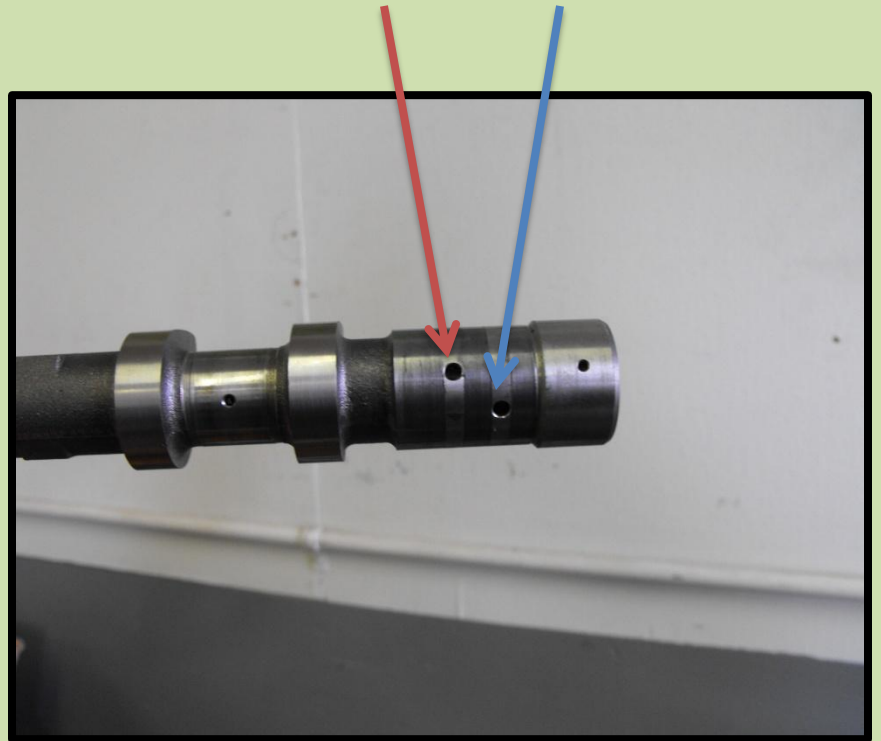
- OCV directs pressure to/from these ports in the first camshaft bearing



1st cam journal "A" and "B" ports

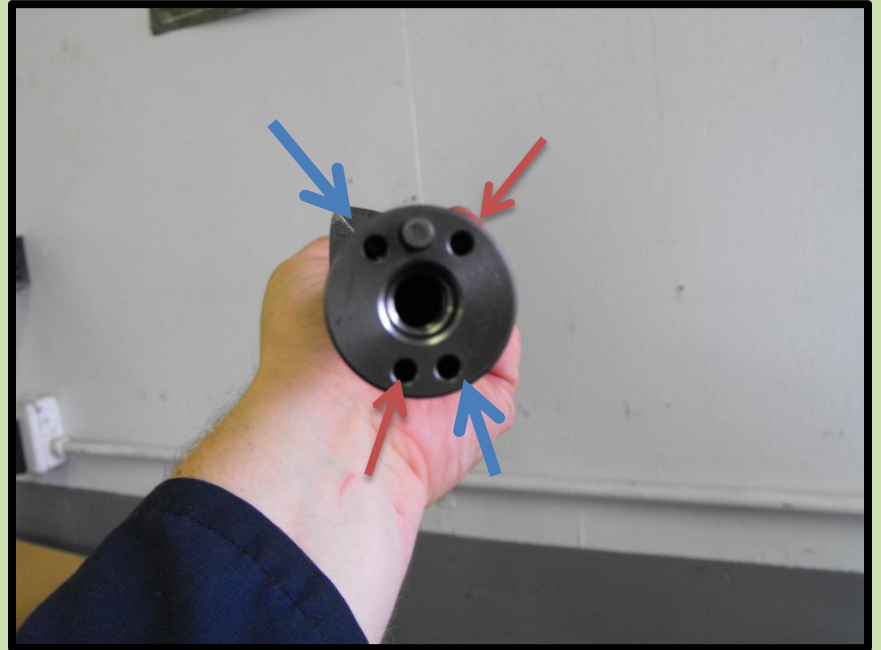
Phaser Style: Hydraulic

- Oil flows into/out of the camshaft
- Passageways connect from the bearing journal to the front nose of the camshaft



Phaser Style: Hydraulic

- Oil is directed to the nose of the camshaft to 4 ports
- 2 ports are shared diagonally
- This allows for supply and venting/exhaust



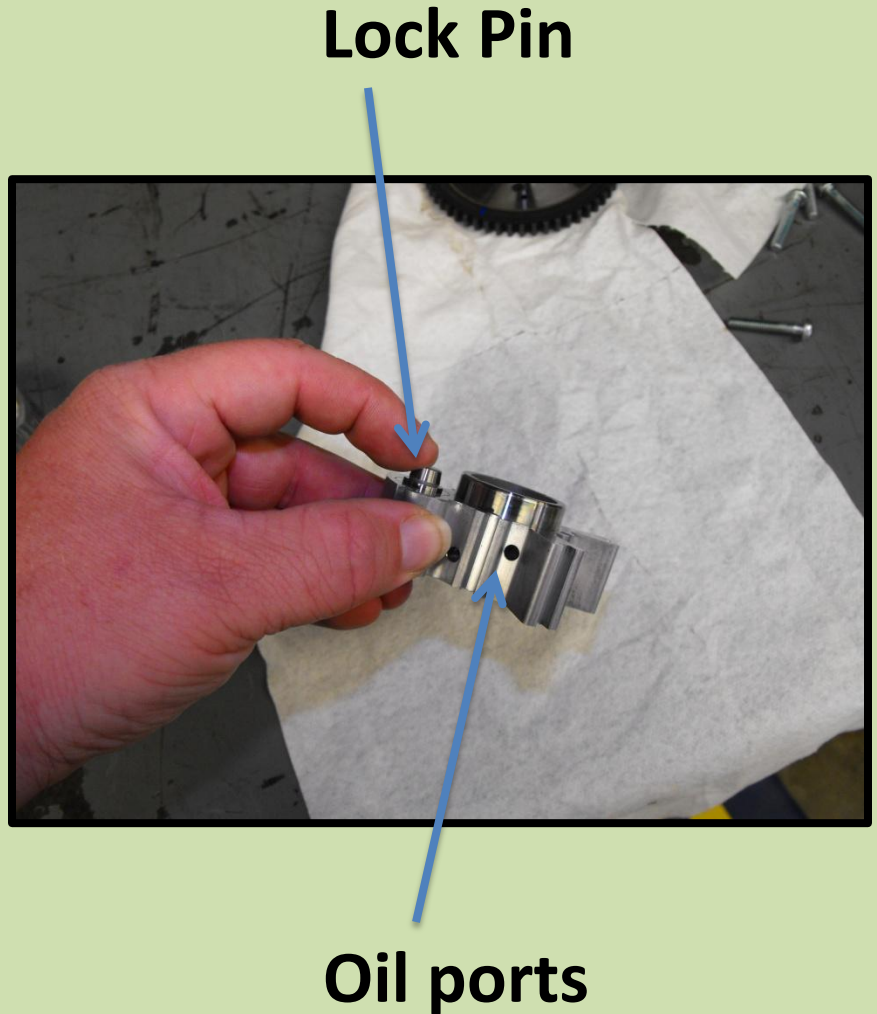
Phaser Style: Hydraulic

- The 4 camshaft ports connect to 4 ports (2 groups of 2 ports) on the phaser assembly

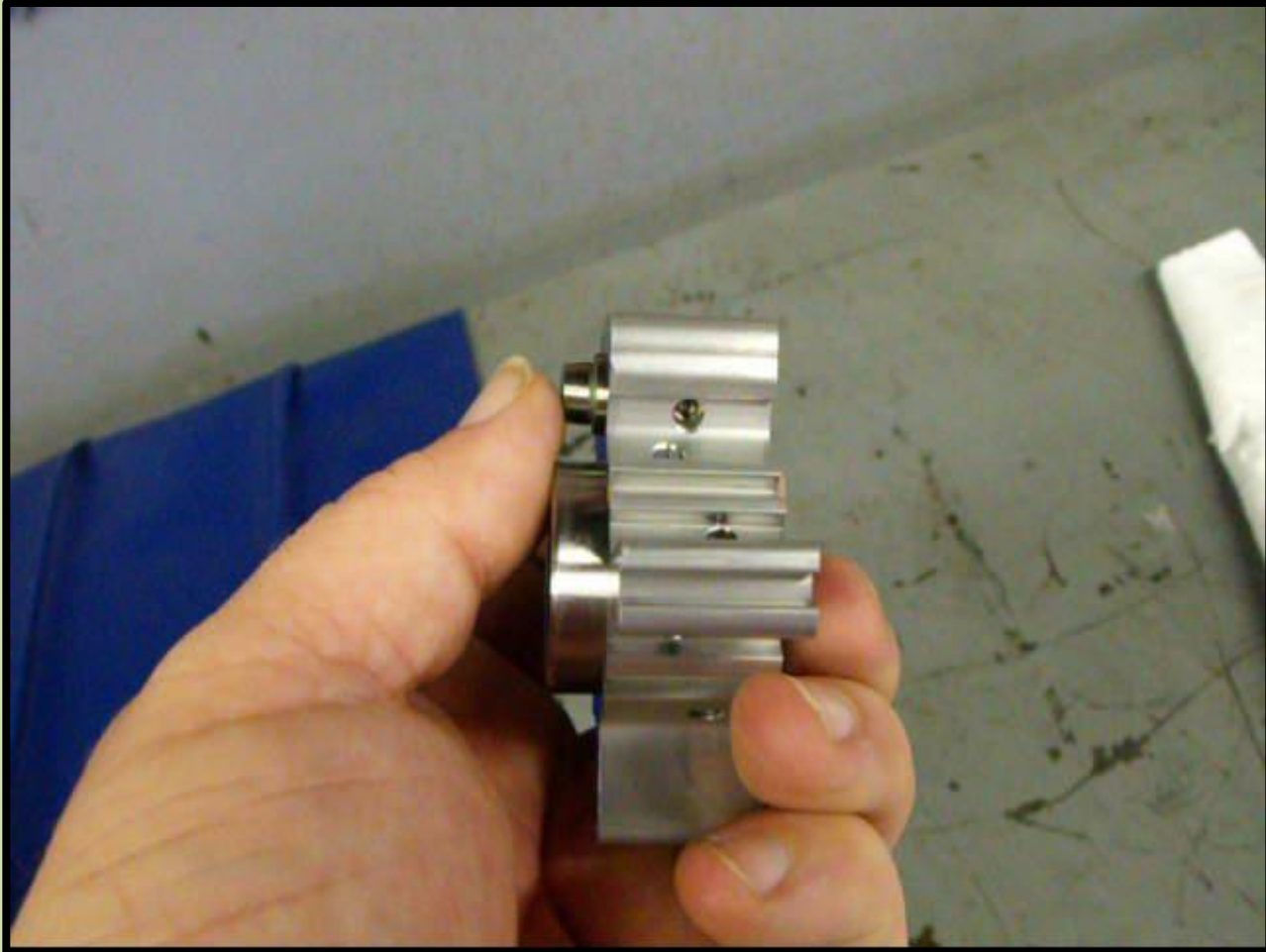


Phaser Style: Hydraulic

- There are 8 ports on the rotor
- The rotor also has a spring loaded lock pin
- Oil pressure unlocks the pin

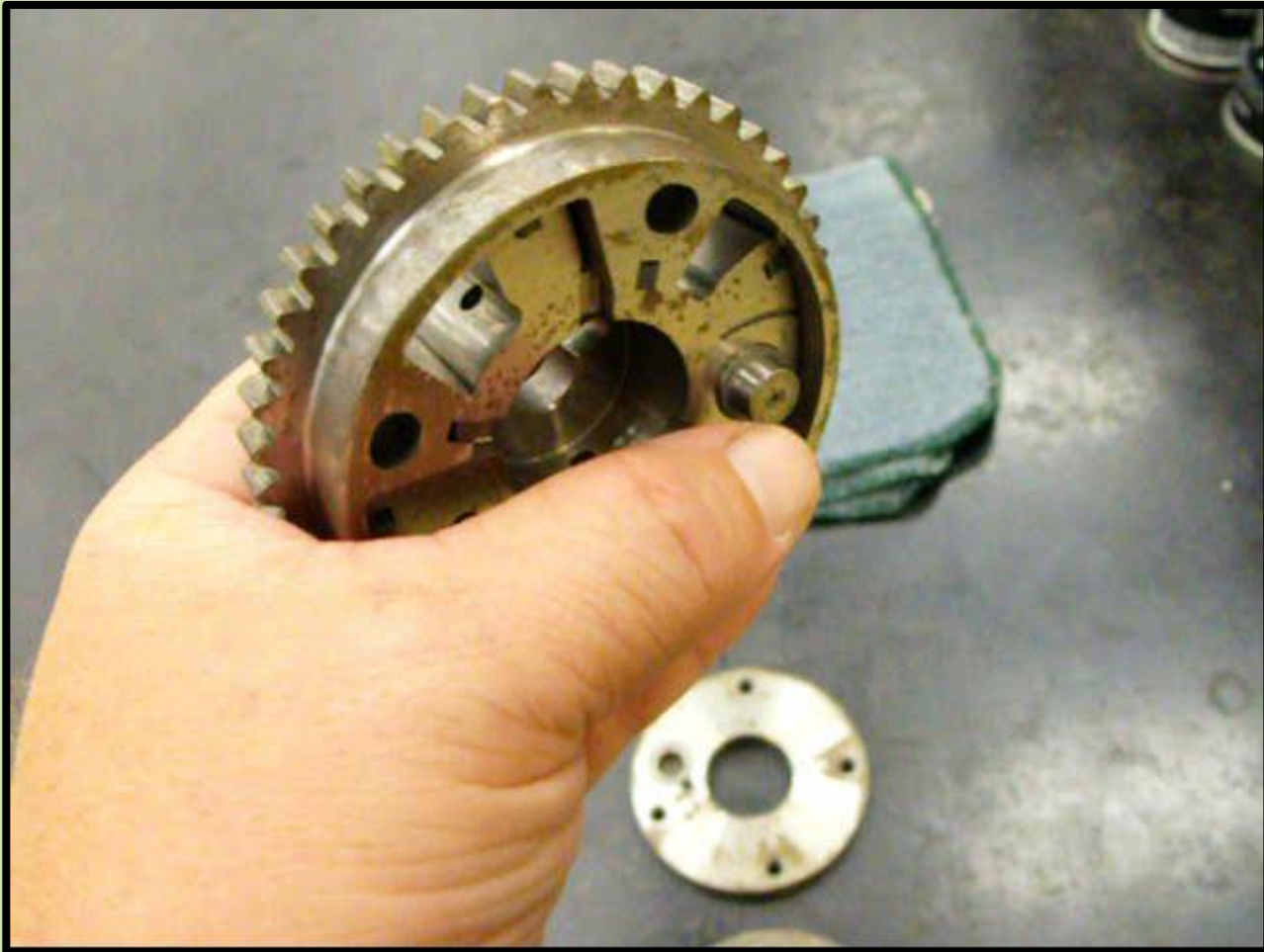


Phaser Style: Hydraulic



Lock pin video clip #1

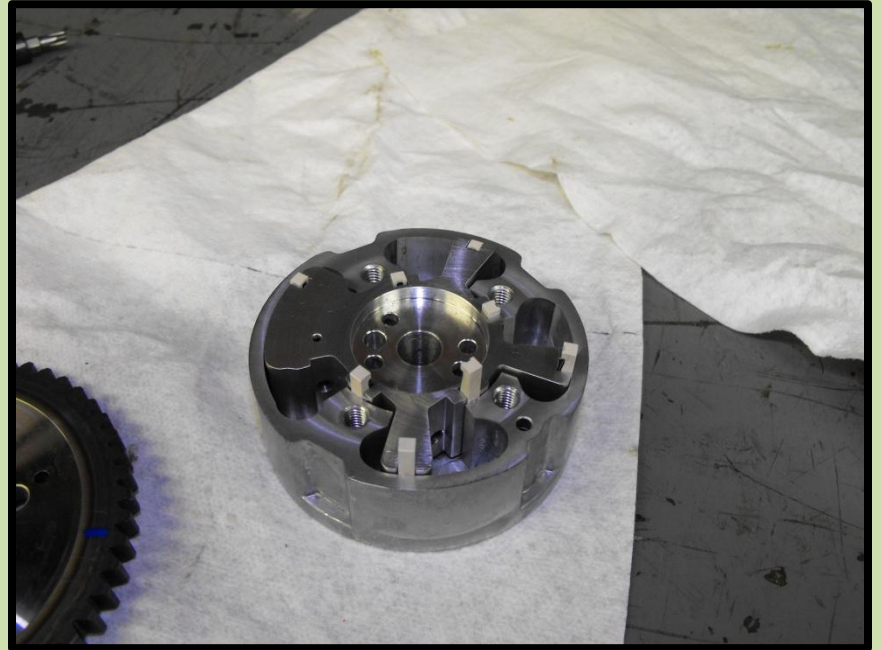
Phaser Style: Hydraulic



Lock pin video clip #2

Phaser Style: Hydraulic

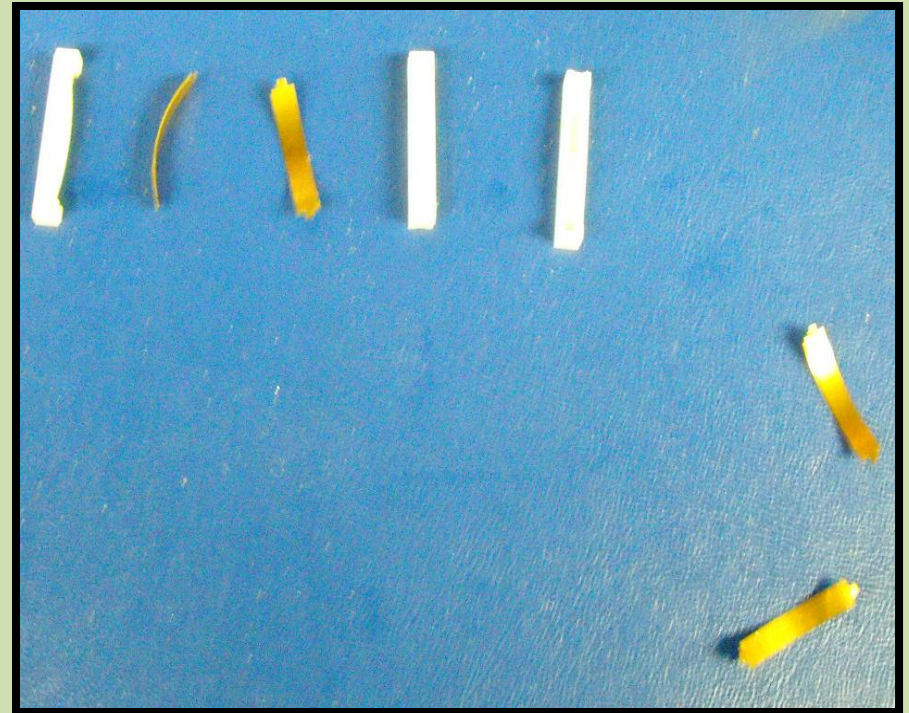
- There are 8 oil seals between the rotor and the housing
- These seals are spring loaded with a small strut spring



4 chambers: **A** 4 chambers: **B**

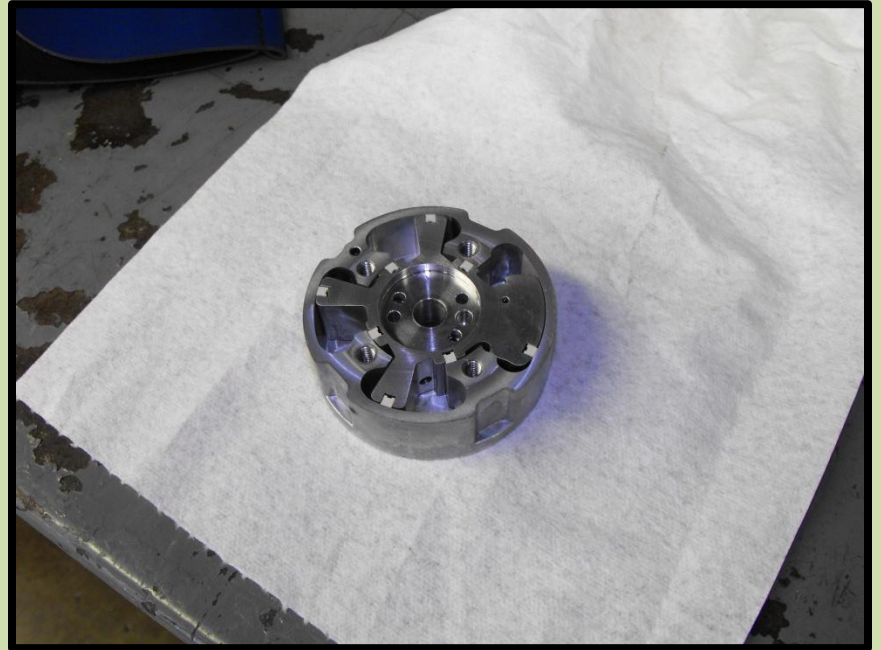
Phaser Style: Hydraulic

- Phaser oil seals and strut springs
- Slide into machined grooves
- Provides seal between chambers



Phaser Style: Hydraulic

- Oil fed into 4 chambers
- Oil exhausted out of 4 chambers
- Controlling the OCV feeds can alter 20 cam degrees from default position



Phaser Style: Hydraulic

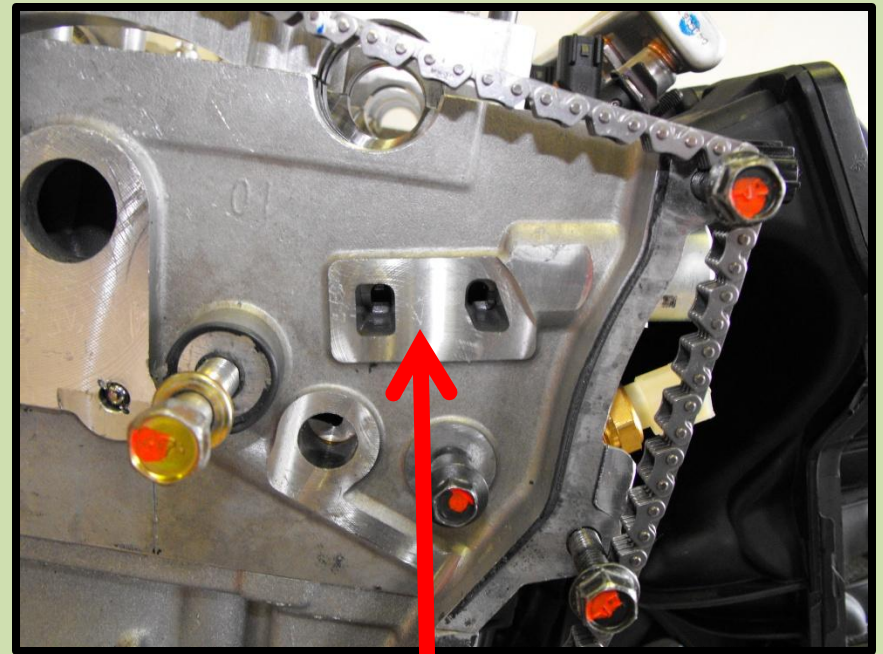


Movement video clip

Phaser Style: Hydraulic

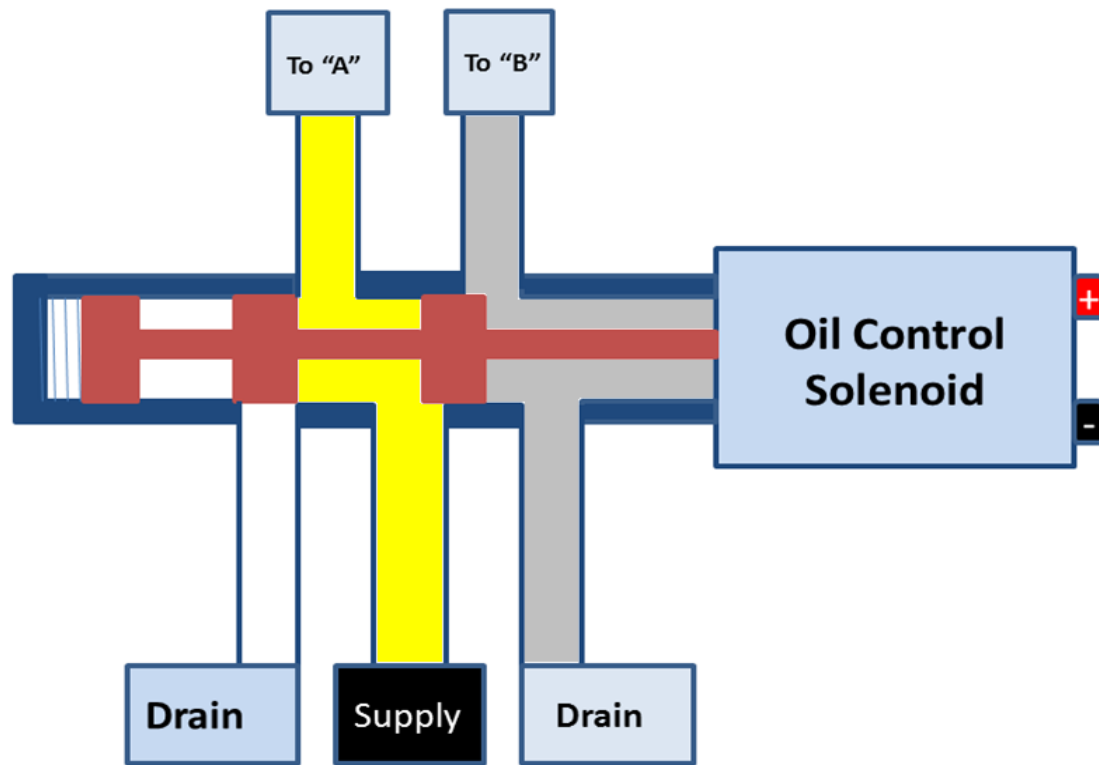
Path of oil vented *from* phaser:

1. Rotor
2. Camshaft
3. Cam journal passage ports
4. Galley back to the oil control valve
5. Exhausted into the timing chain cover ports

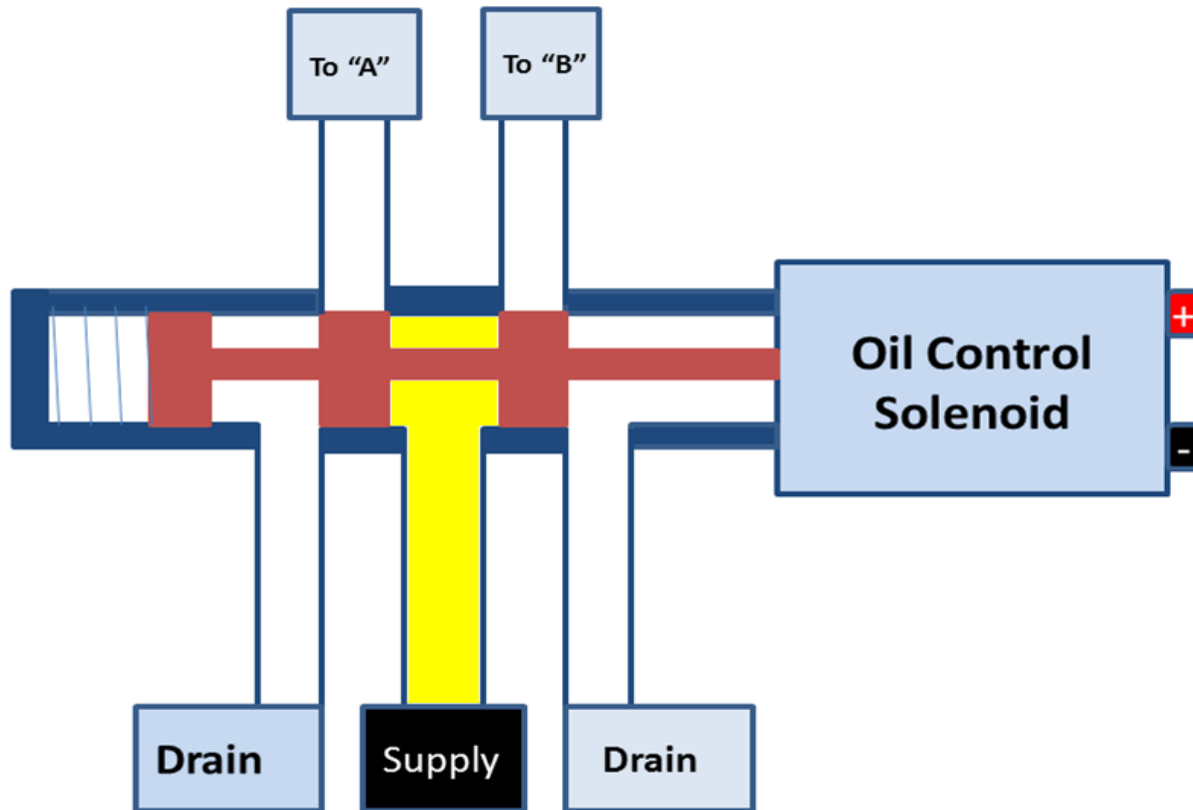


Oil Return Ports

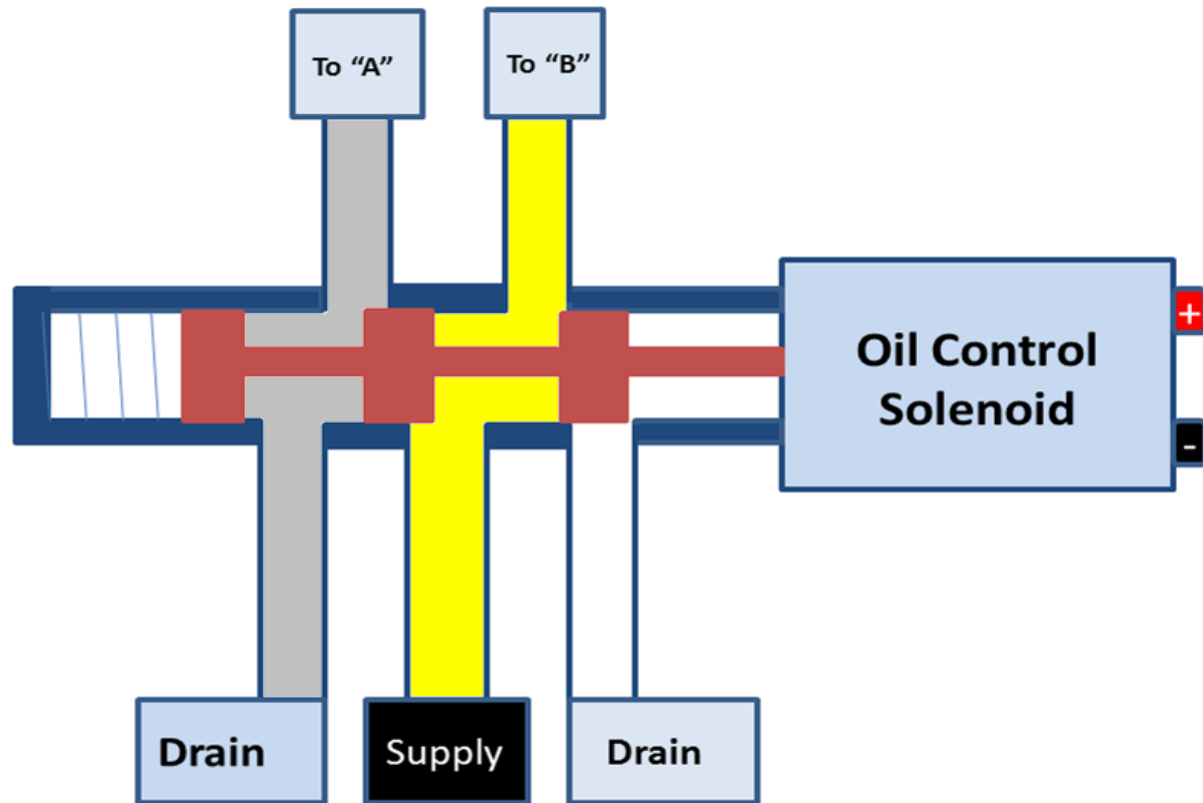
Phaser Style: Hydraulic



Phaser Style: Hydraulic



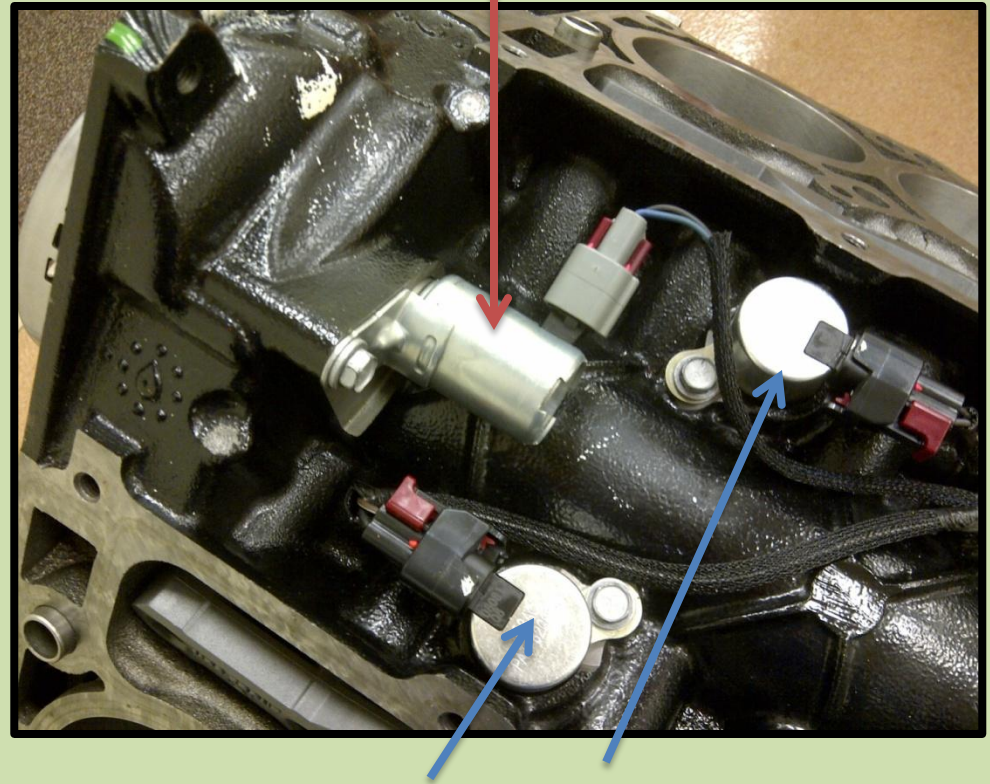
Phaser Style: Hydraulic



Phaser Style: Electrical

- Typically one solenoid controlled oil control valve per camshaft
- 2 wire solenoid controlled by PCM

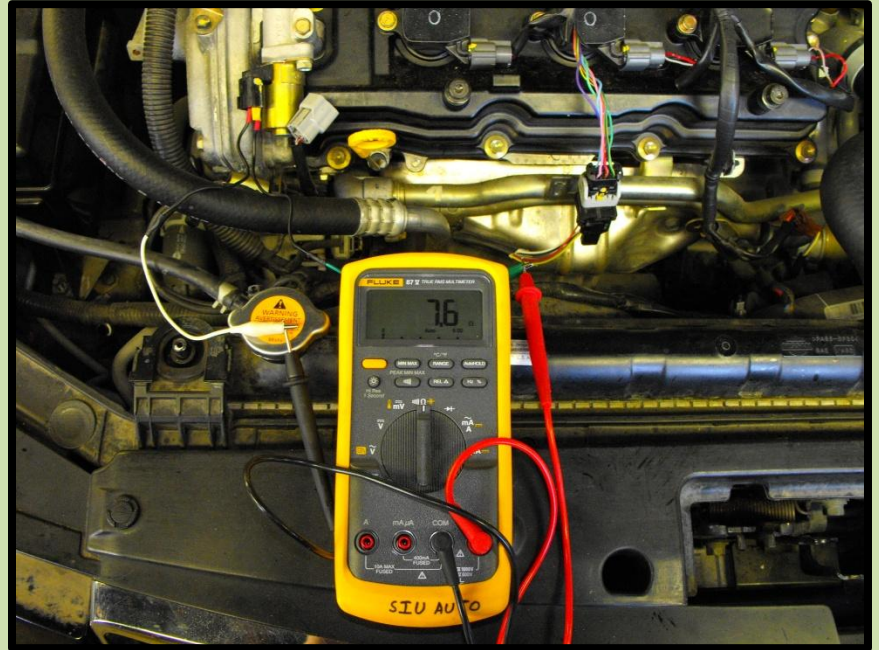
OCV Solenoid



Cylinder Deactivation Solenoids
(Dodge Pushrod V-8 shown)

Phaser Style: Electrical

- Most oil control solenoids are 7-12 ohms @ room temperature
- They can vary with engine temperature

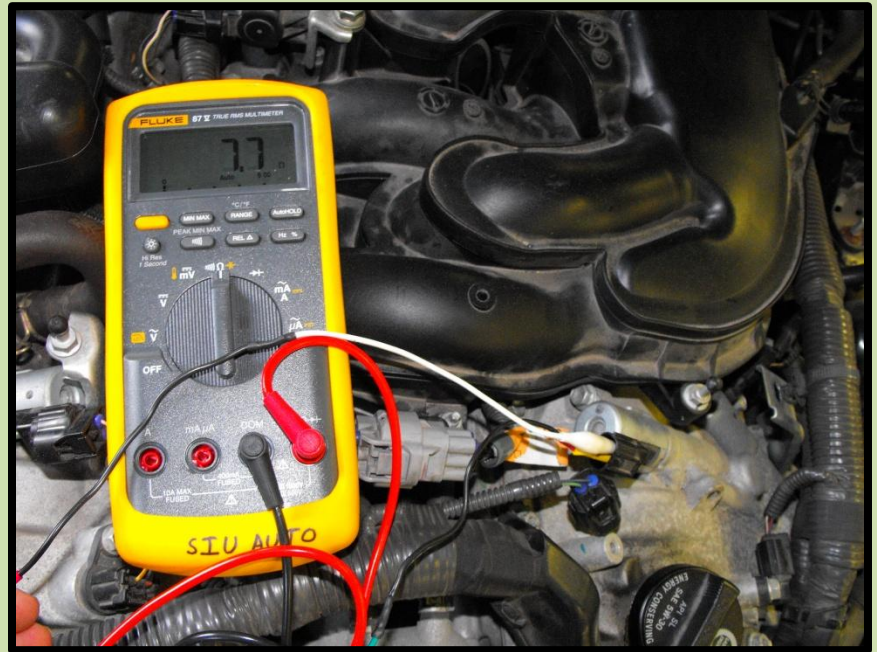


2007 Nissan Maxima 3.5

Phaser Style: Electrical



2005 Ford 5.4 Litre F-150



2006 Lexus IS 350

Phaser Style: Electrical

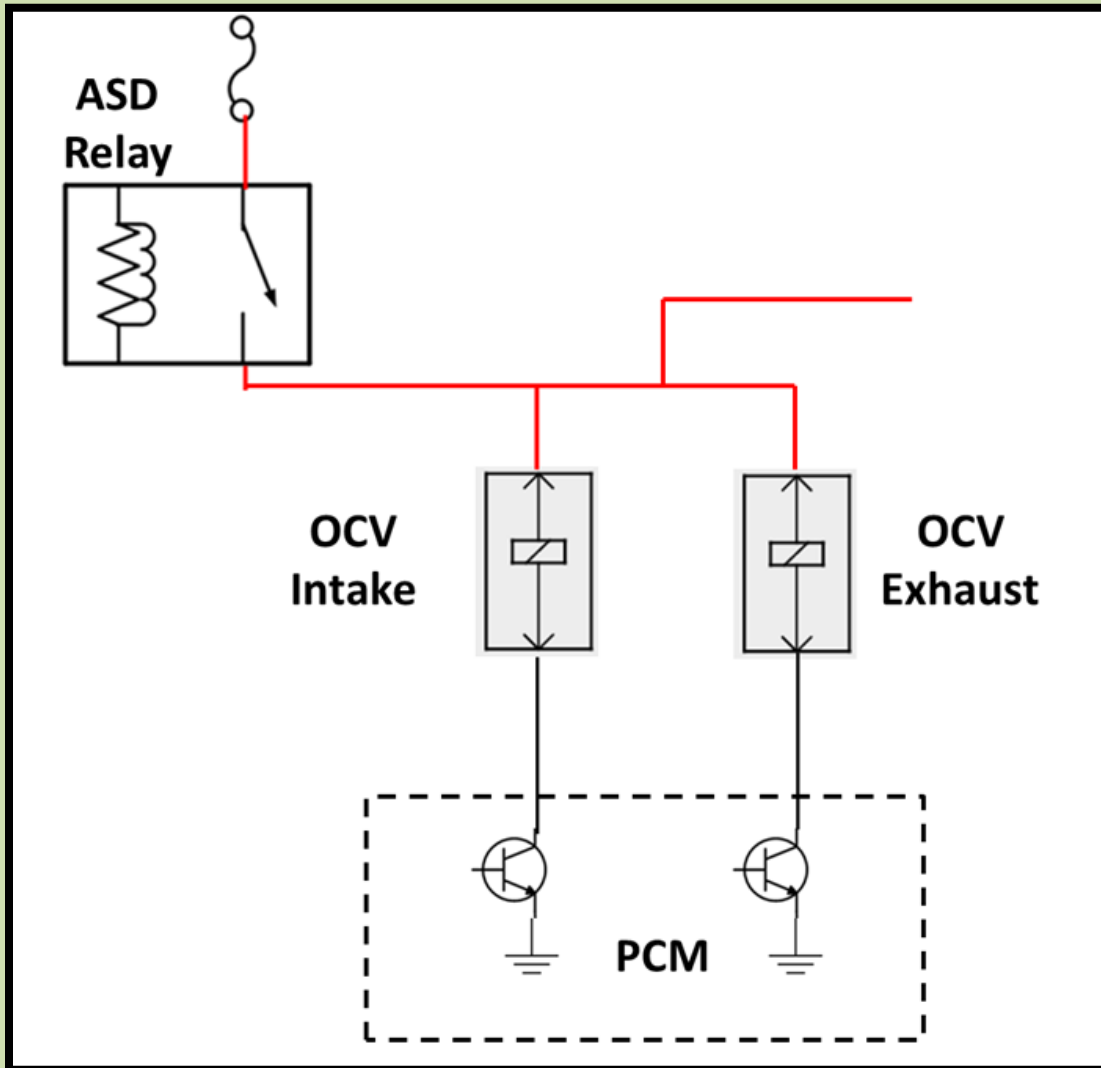


2012 Jeep Wrangler 3.6



2008 Dodge Caliber 2.4

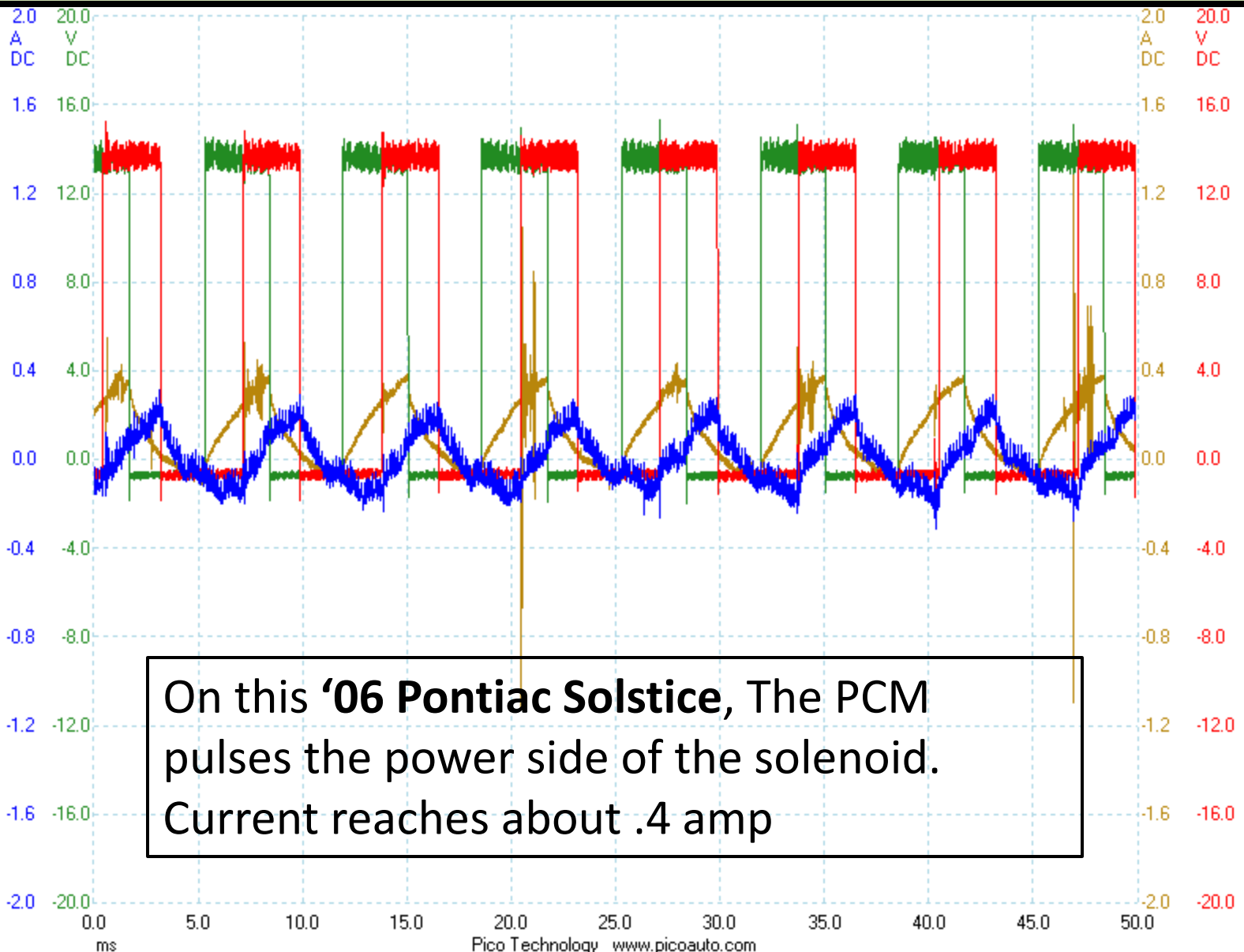
Phaser Style: Electrical



Basic
Schematic

2012 Dodge
Caliber 2.4

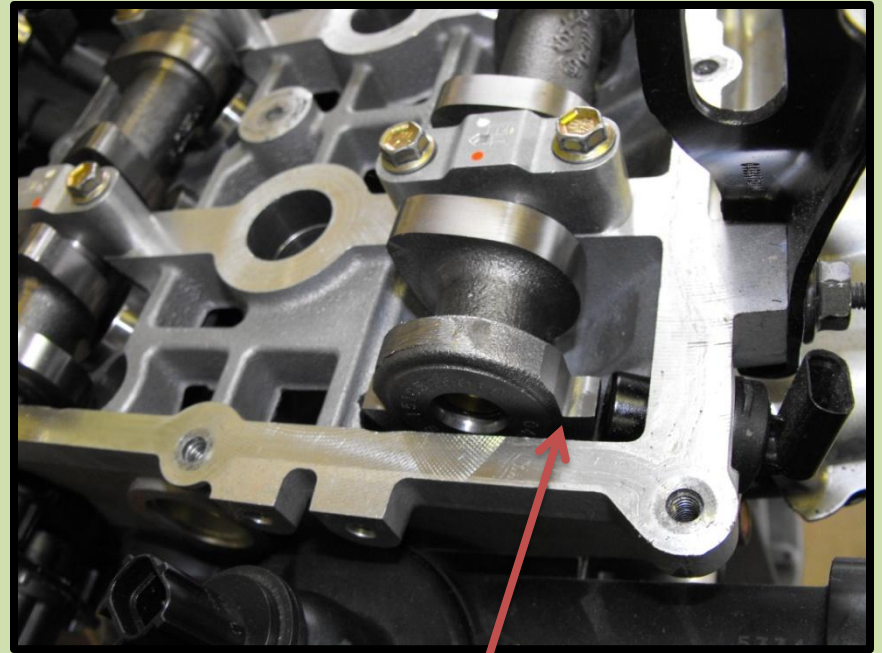
PCM grounds
OCV solenoid



On this '06 Pontiac Solstice, The PCM pulses the power side of the solenoid. Current reaches about .4 amp

Phaser Style: Electrical

- Cam sensor used to monitor VVT
- CKP compared to CMP
- Excess variance triggers a DTC



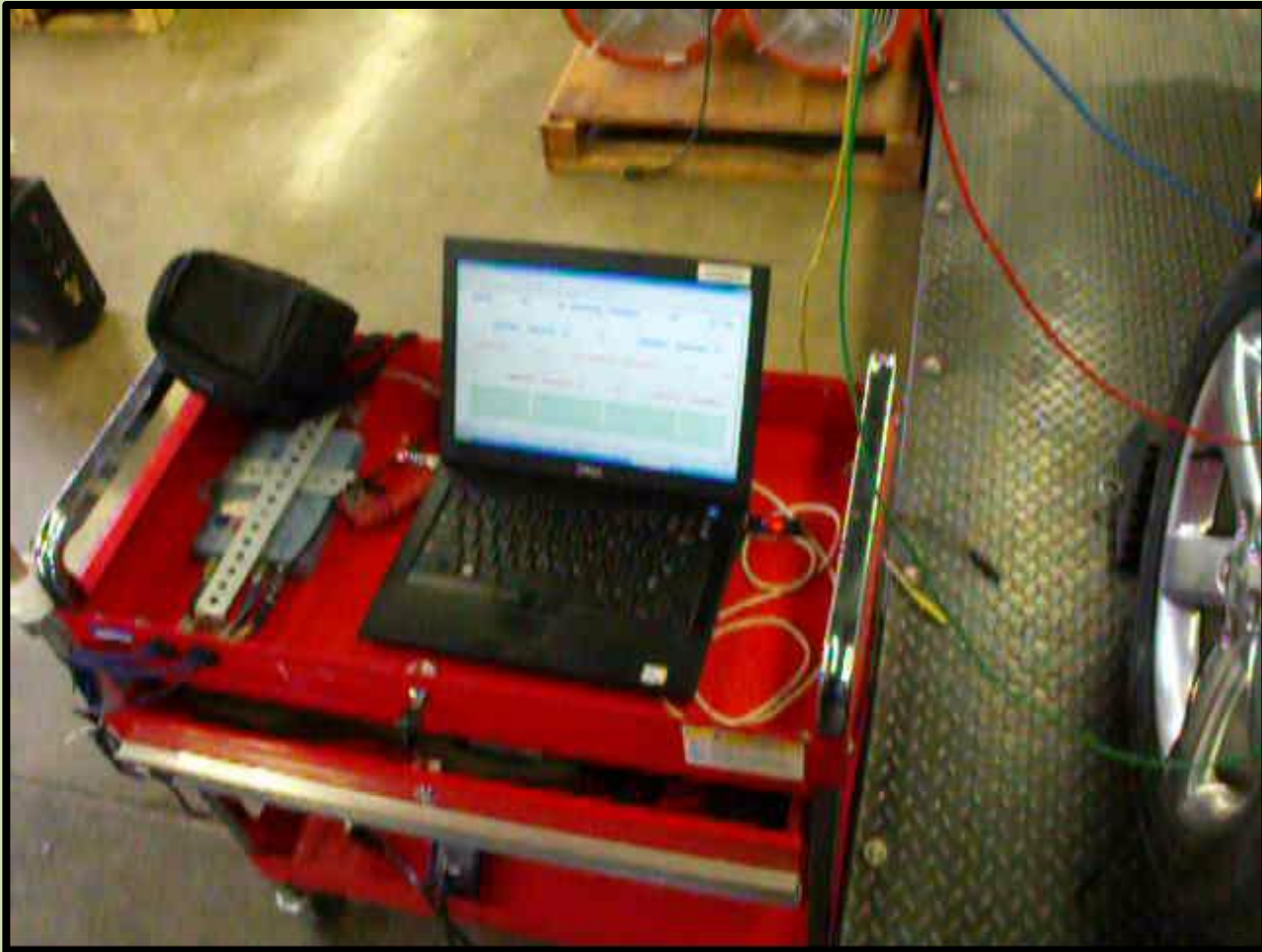
3 wire hall effect CMP sensor,
“half moon” style tone ring

Phaser Style: Electrical



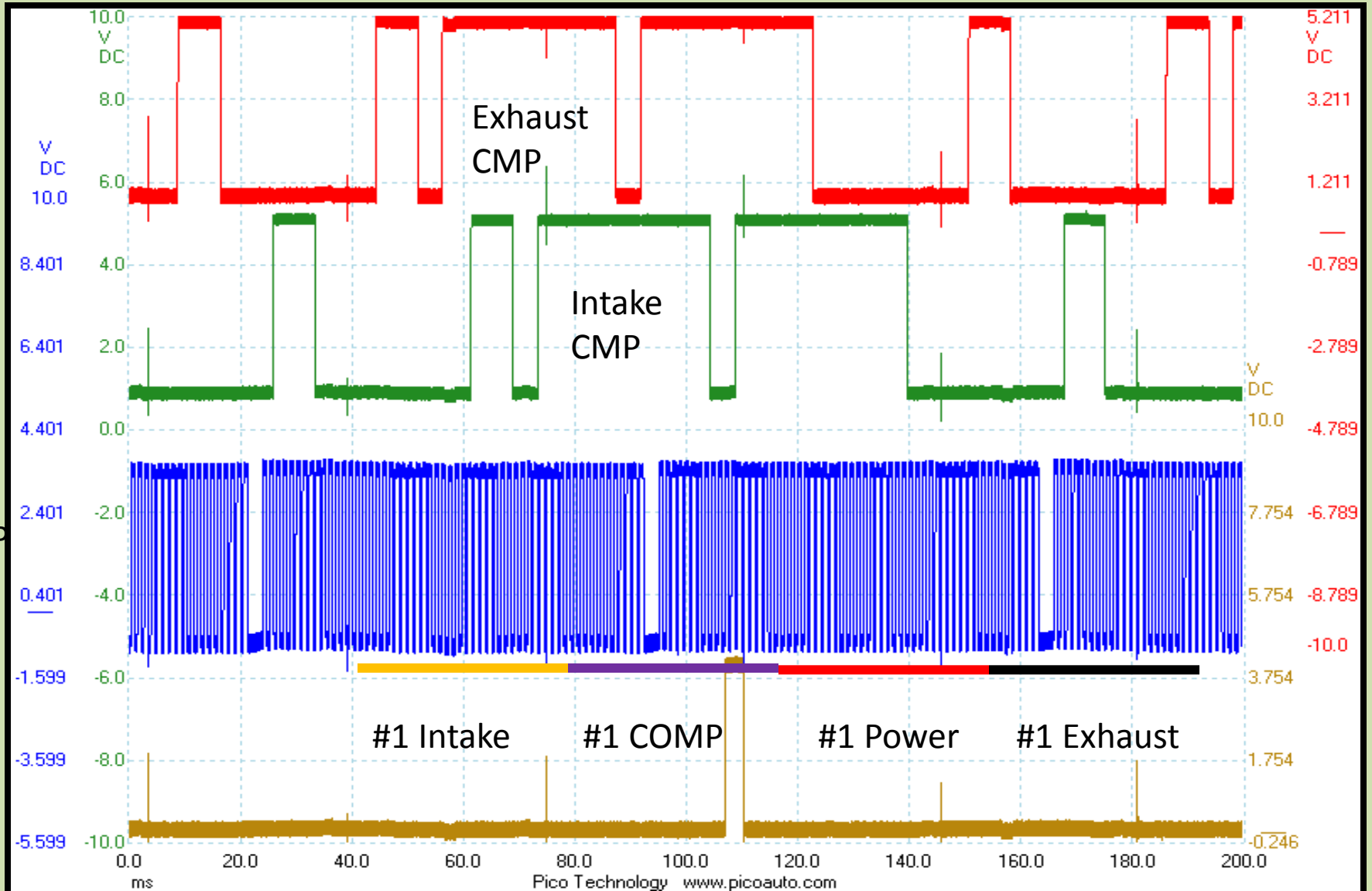
2303 manual activation video clip

Phaser Style: Electrical

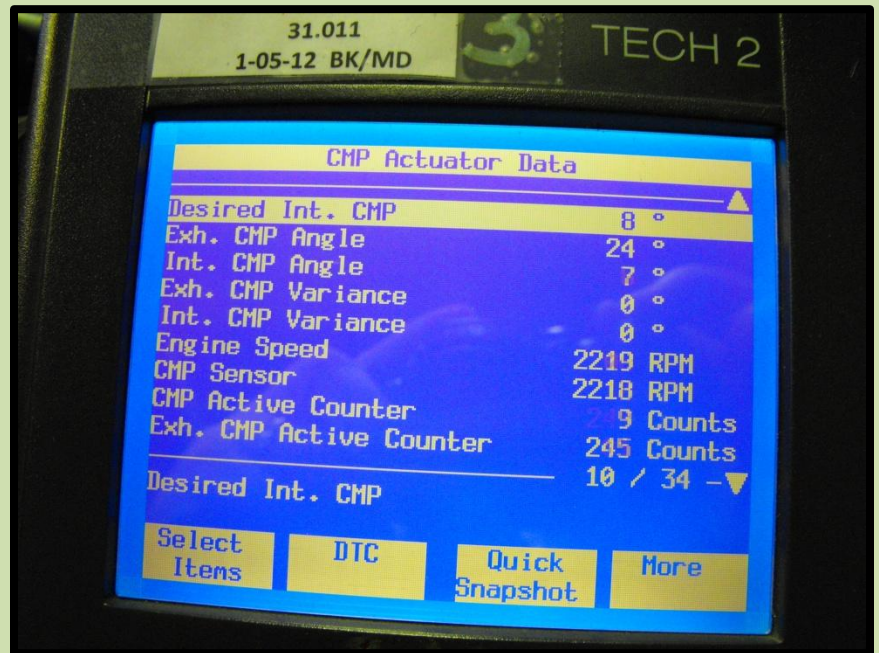
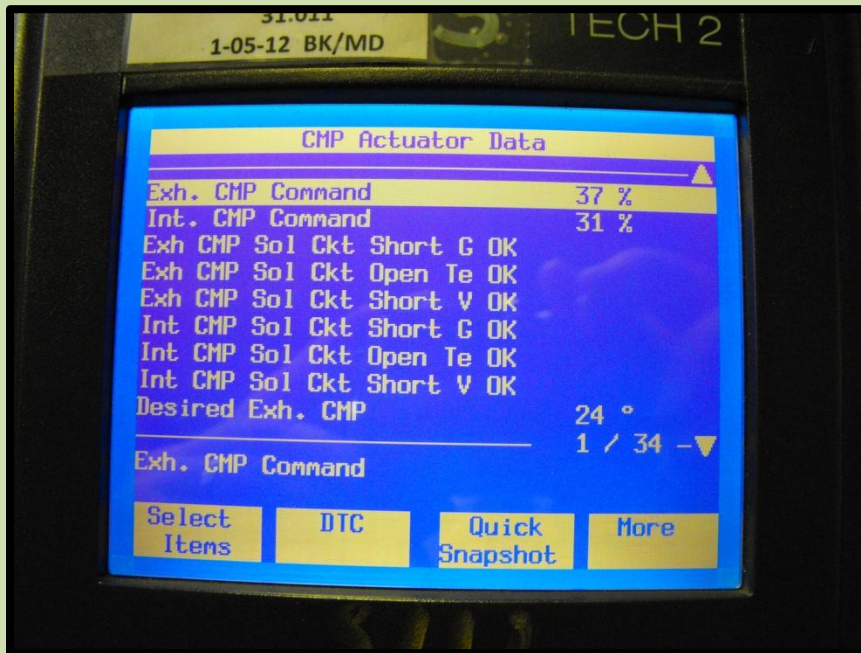


2404 activate intake video clip

Phaser Style: Electrical



Phaser Style: Electrical



Data Stream from '06 Solstice

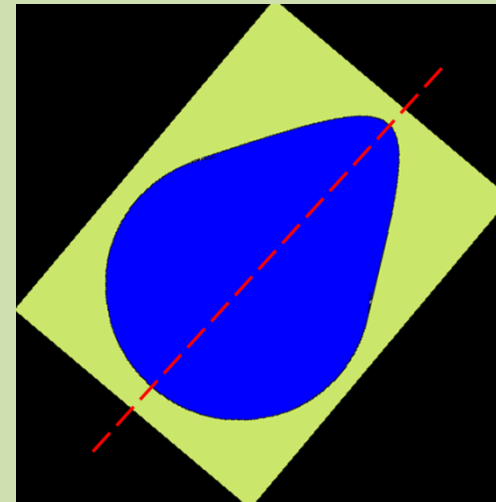
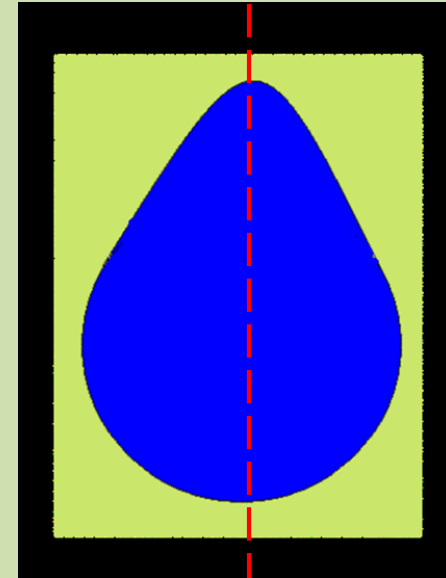
Phaser Style: Electrical

Flash	Data	DTCs	Actuators	System Tests	Misc Functions	ECU Details
Double-click row selection to graph data element, or check multiple elements and press "Show Graph". Click on column heading to sort table. selections to re-order table elements.						
Graph	Name	Value	Unit			
<input type="checkbox"/>	Crank Signal Missing	False				
<input type="checkbox"/>	Crank Sync State	Out of Sync				
<input type="checkbox"/>	Crank System Fault and in Limp-Home mode.	False				
<input type="checkbox"/>	Exhaust Cam 1 / Crank Difference	1.0	EngineDeg			
<input type="checkbox"/>	Exhaust Cam 1 Duty Cycle	0.0	%DC			
<input type="checkbox"/>	Exhaust Cam 1 Desired Position	---	EngineDeg			
<input type="checkbox"/>	Exhaust Cam 1 Actual Position	125.0	EngineDeg			
<input type="checkbox"/>	Exhaust Cam 2 Duty Cycle	0.0	%DC			
<input type="checkbox"/>	Exhaust Cam 2 Desired Position	0.0	EngineDeg			

Data Stream from '12 Challenger

Phaser Style: Control Strategy

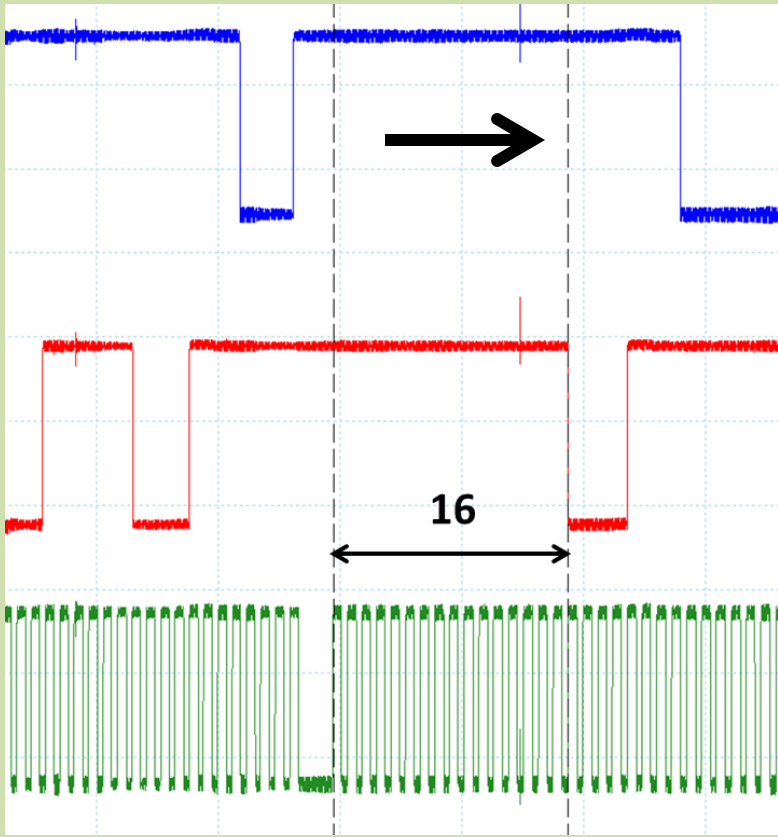
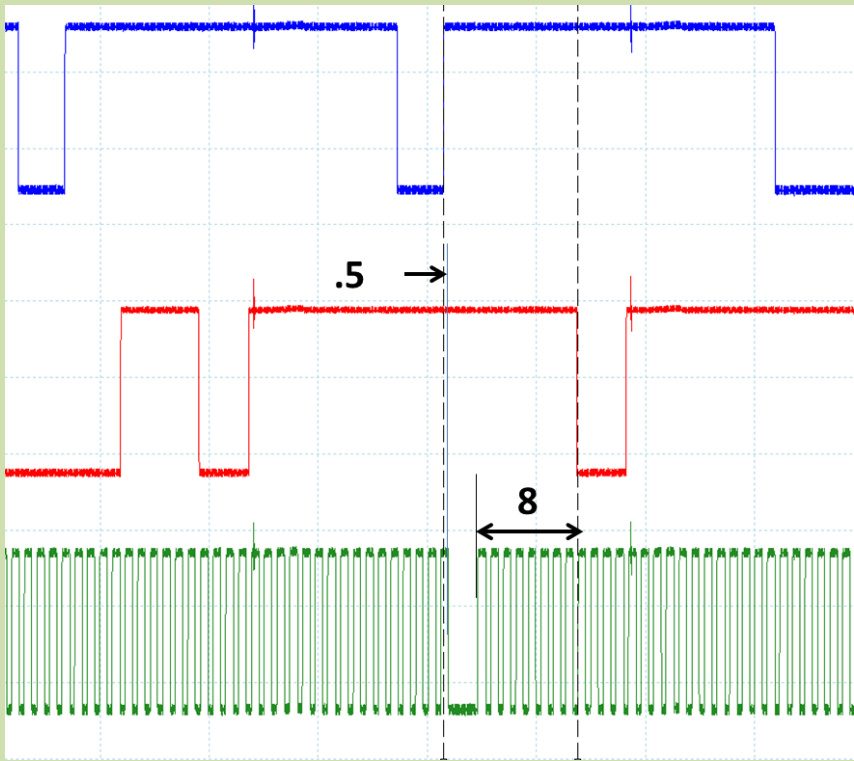
- PCM can alter cam position up to 40-45°
- Example *Intake Cam*
SPEC: 260° Duration
- Default position (*Retard*)
opens 2° ATDC closes 262° ATDC or 82° ABDC
Centerline= 132°
- At 40° advance: opens 38° BTDC closes 42° ABDC
Centerline= 92°



Phaser Style: Control Strategy

CKP vs. exhaust in Red @idle

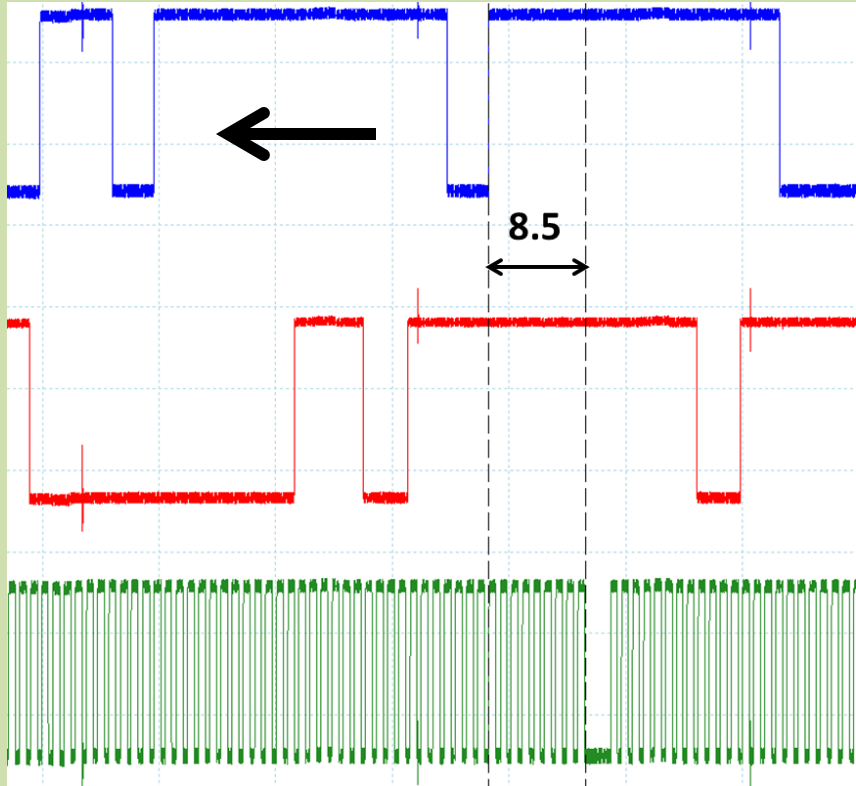
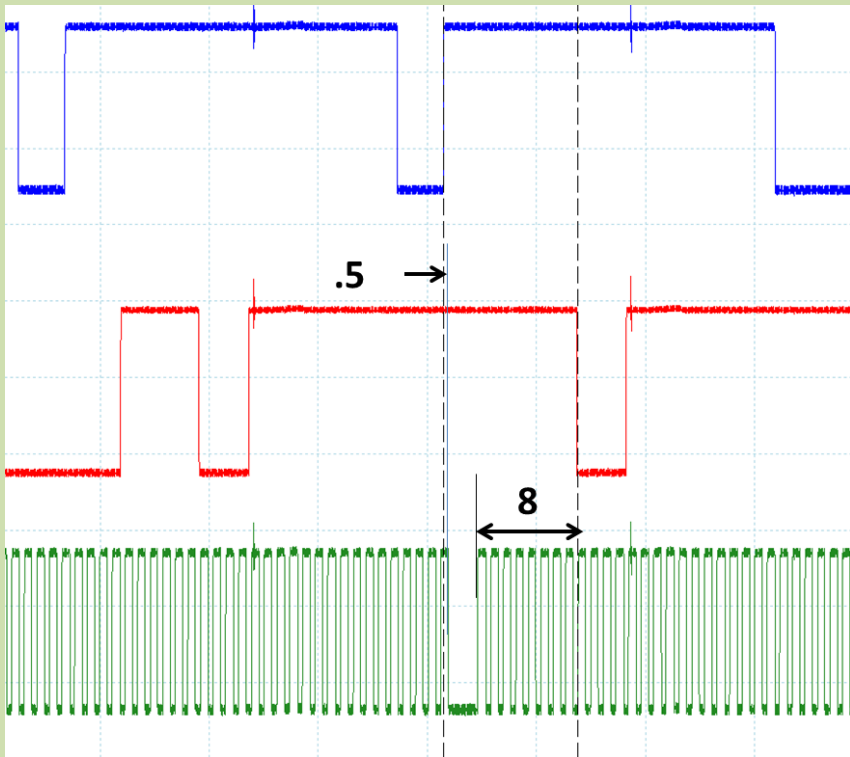
Exhaust @ full retard



Phaser Style: Control Strategy

CKP vs. intake in blue @ idle

Intake @ full advance



Phaser Style: Control Strategy



Dyno Run video clip

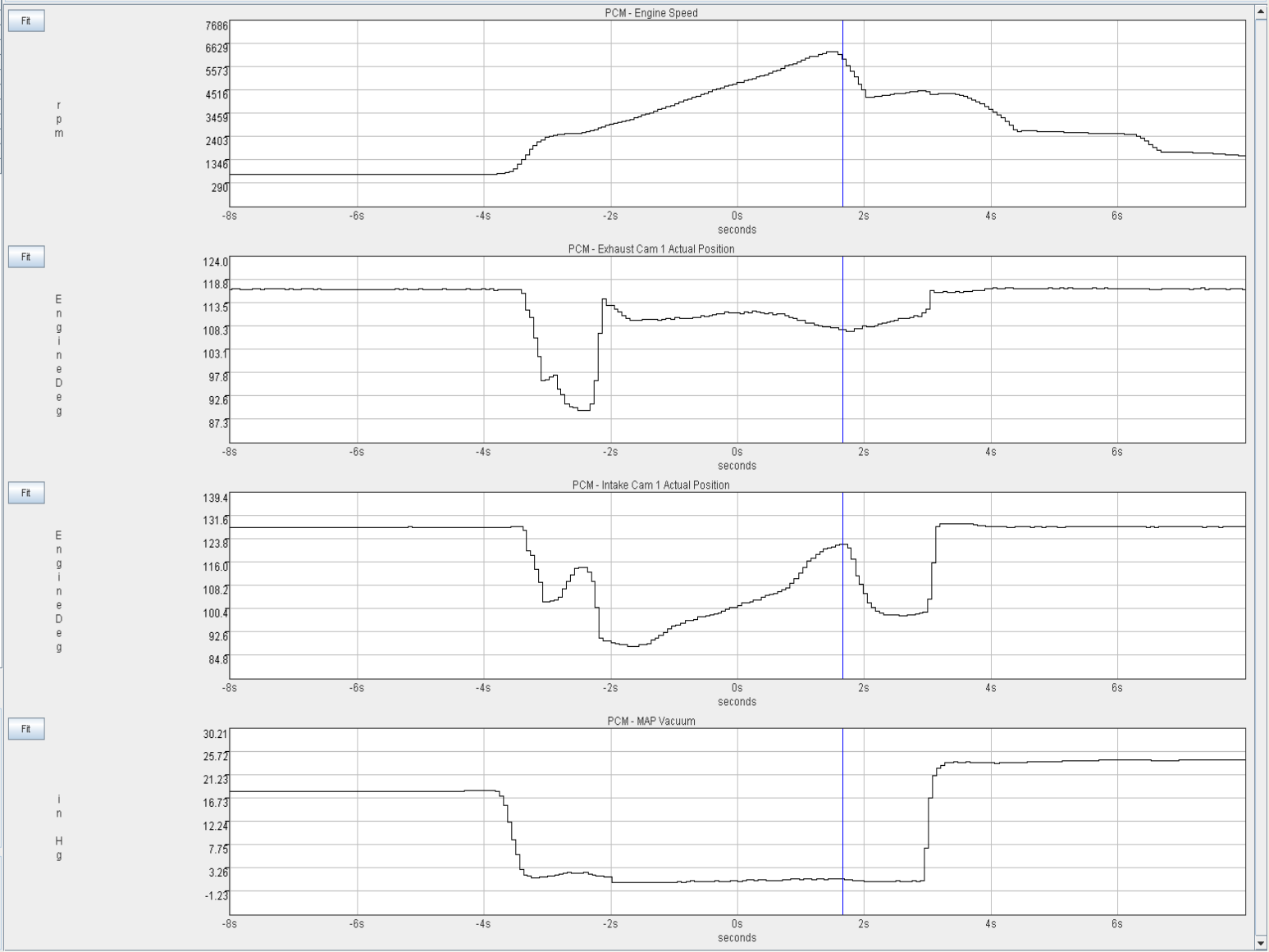
Graph	ECU	Name	Value	Units
<input type="checkbox"/>	PCM	APP 1 Volts	4.5654	Volts
<input type="checkbox"/>	PCM	APP 2 Volts	2.2778	Volts
<input checked="" type="checkbox"/>	PCM	Engine Speed	5932	rpm
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	107.5	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	52.3784	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	107.2	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Duty Cycle	51.7253	%DC
<input type="checkbox"/>	PCM	Injector Pulse Width Cylinder 1	0	US
<input checked="" type="checkbox"/>	PCM	Intake Cam 1 Actual Position	122.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Duty Cycle	53.1079	%DC
<input type="checkbox"/>	PCM	Intake Cam 2 Actual Position	121.7	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Duty Cycle	50.8677	%DC
<input checked="" type="checkbox"/>	PCM	MAP Vacuum	1.00	in Hg
<input type="checkbox"/>	PCM	Throttle Blade Position	76	%
<input type="checkbox"/>	PCM	Vehicle Speed	43.5	MPH
<input type="checkbox"/>	PCM	VVT Oil Pressure	95	psi
<input type="checkbox"/>	PCM	VVT Oil Temp	189	F
<input type="checkbox"/>	PCM	VVT Test Step Count Spec	9	Counts

Control Panel

< Nudge Time: 001.672 Nudge >

Zoom In Zoom Out GoTo Trigger

**2012 Jeep
Wrangler 3.6
W.O.T. stab**



Select All Deselect All

Event Recording

Template Name: dixon jc vvt test 9 19 12

Total Recording Time: 60

Recording File Comment: dixon 318 4v 12

Vehicle Information

VIN: 1 [redacted]

Year / Body: 2012JK

Engine: 3.6L

Graph	ECU	Name	Value	Units
<input type="checkbox"/>	PCM	APP 1 Volts	1.2562	Volts
<input type="checkbox"/>	PCM	APP 2 Volts	0.6354	Volts
<input checked="" type="checkbox"/>	PCM	Engine Speed	1962	rpm
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	74.6	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	51.1607	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	74.6	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Duty Cycle	51.8504	%DC
<input type="checkbox"/>	PCM	Injector Pulse Width Cylinder 1	5912	US
<input checked="" type="checkbox"/>	PCM	Intake Cam 1 Actual Position	127.9	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Intake Cam 2 Actual Position	127.6	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Duty Cycle	0.0000	%DC
<input checked="" type="checkbox"/>	PCM	MAP Vacuum	6.31	in Hg
<input type="checkbox"/>	PCM	Throttle Blade Position	11	%
<input type="checkbox"/>	PCM	Vehicle Speed	21.5	MPH
<input type="checkbox"/>	PCM	VVT Oil Pressure	44	psi
<input type="checkbox"/>	PCM	VVT Oil Temp	181	F
<input type="checkbox"/>	PCM	VVT Test Step Count Spec	9	Counts

2012 Wrangler 3.6
Mild acceleration

Control Panel

< Nudge

Time : -014.382

Nudge >

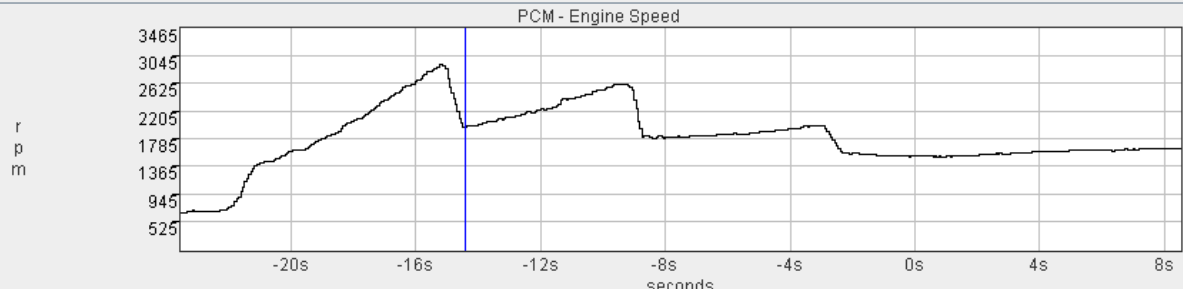


Zoom In

Zoom Out

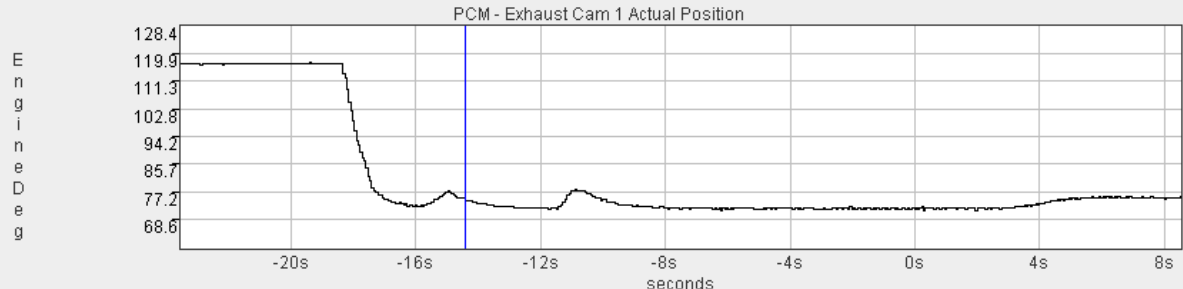
GoTo Trigger

Fit



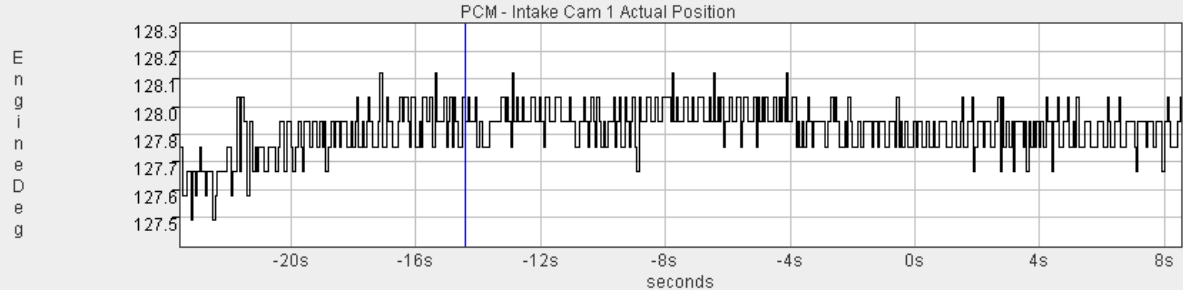
r
p
m

Fit



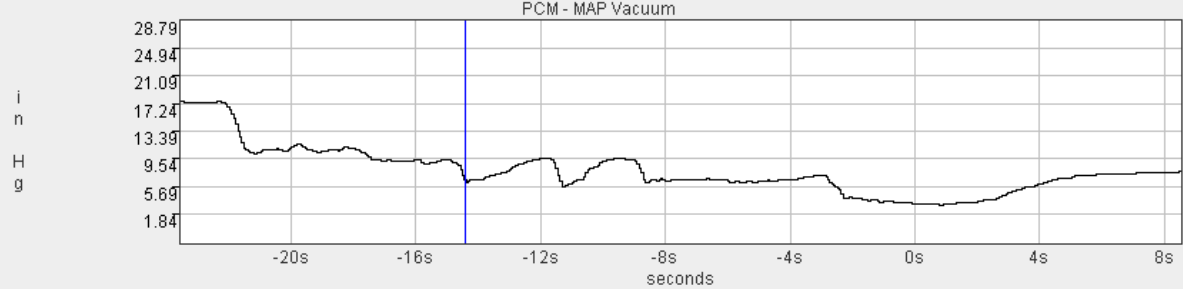
E
n
g
i
n
e
D
e
g

Fit



E
n
g
i
n
e
D
e
g

Fit



i
n
H
g

Select All

Deselect All

Event Recording

Template Name : dixon jc vvt test 9 19 12

Total Recording Time : 60

Recording File Comment : dixon n 318 4v 12

Vehicle Information

VIN:

Year / Body : 2012JK

Engine : 3.6L

Graph	ECU	Name	Value	Units
<input type="checkbox"/>	PCM	APP 1 Volts	0.4448	Volts
<input type="checkbox"/>	PCM	APP 2 Volts	0.2248	Volts
<input checked="" type="checkbox"/>	PCM	Engine Speed	674	rpm
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	116.6	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	116.7	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Injector Pulse Width Cylinder 1	3464	US
<input checked="" type="checkbox"/>	PCM	Intake Cam 1 Actual Position	127.9	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Intake Cam 2 Actual Position	127.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Duty Cycle	0.0000	%DC
<input checked="" type="checkbox"/>	PCM	MAP Vacuum	15.52	in Hg
<input type="checkbox"/>	PCM	Throttle Blade Position	3	%
<input type="checkbox"/>	PCM	Vehicle Speed	2.0	MPH
<input type="checkbox"/>	PCM	VVT Oil Pressure	26	psi
<input type="checkbox"/>	PCM	VVT Oil Temp	176	F
<input type="checkbox"/>	PCM	VVT Test Step Count Spec	9	Counts

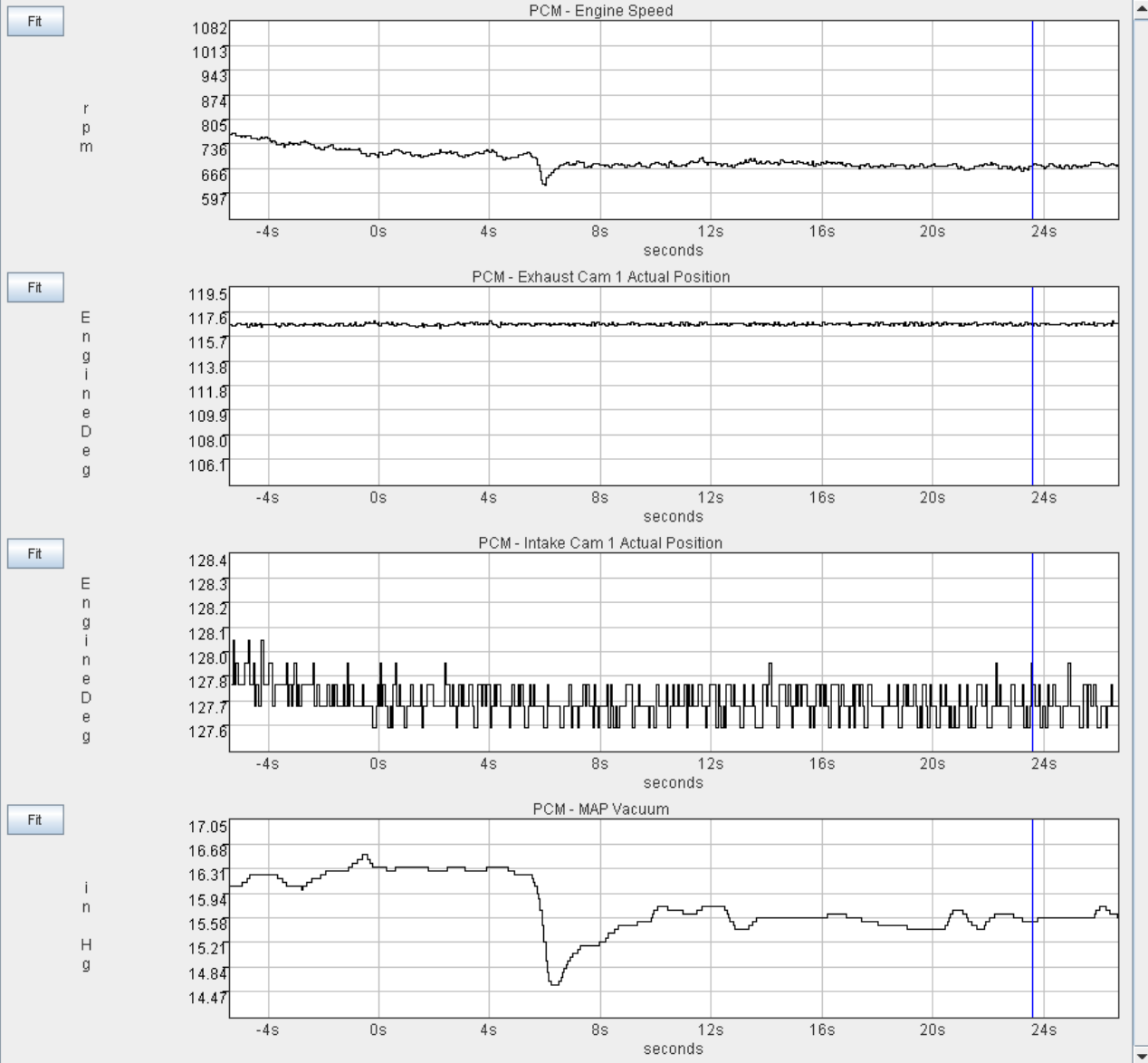
Control Panel

< Nudge Time: 023.569 Nudge >

-30 30

Zoom In Zoom Out GoTo Trigger

**2012 Wrangler 3.6
Idle after start up**



Select All Deselect All

Event Recording

Template Name : dixon jc vvt test 9 19 12

Total Recording Time : 60

Recording File Comment : dixon 318 4v 12

Vehicle Information

VIN :

Year / Body : 2012/JK

Engine : 3.6L

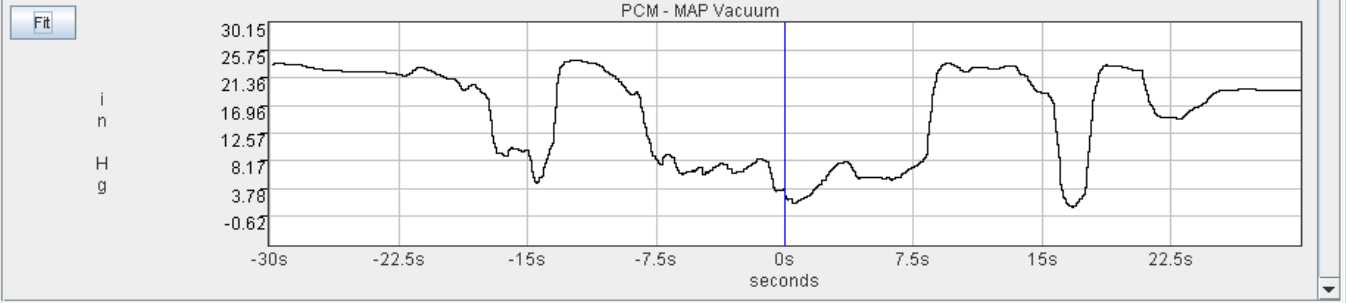
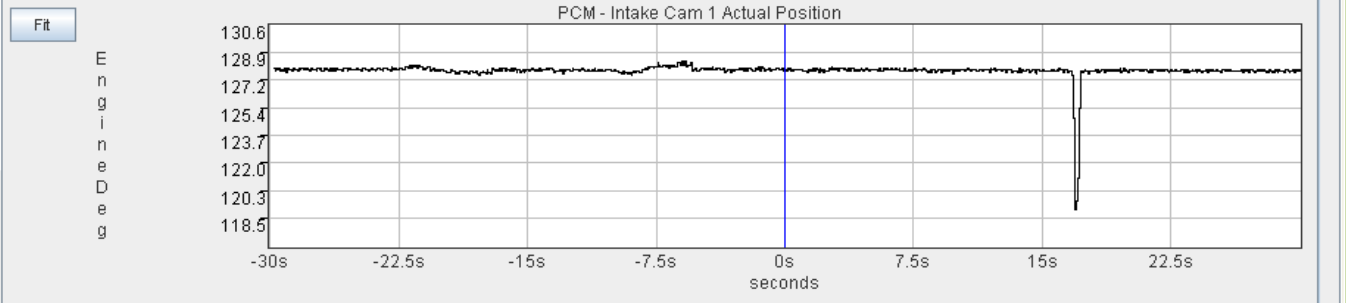
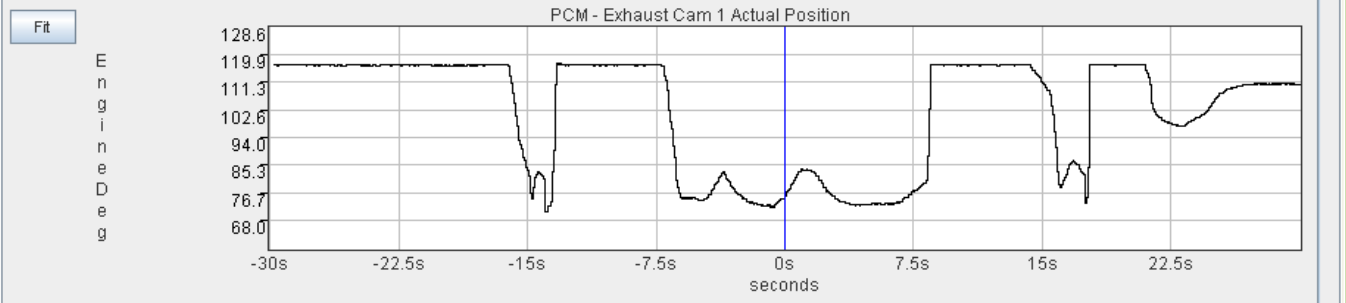
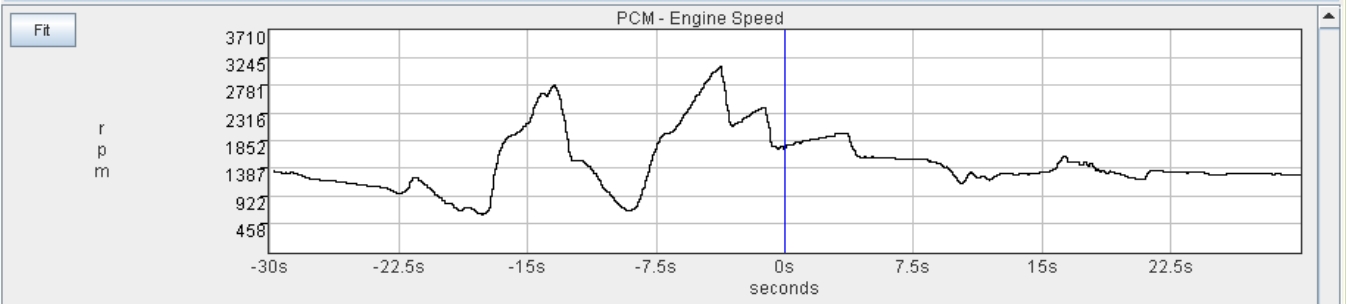
Graph	ECU	Name	Value	Units
<input type="checkbox"/>	PCM	APP 1 Volts	1.4371	Volts
<input type="checkbox"/>	PCM	APP 2 Volts	0.7234	Volts
<input checked="" type="checkbox"/>	PCM	Engine Speed	1708	rpm
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	74.8	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	49.7934	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	75.3	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Duty Cycle	46.8879	%DC
<input type="checkbox"/>	PCM	Injector Pulse Width Cylinder 1	6448	US
<input checked="" type="checkbox"/>	PCM	Intake Cam 1 Actual Position	127.9	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Intake Cam 2 Actual Position	127.5	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Duty Cycle	0.0000	%DC
<input checked="" type="checkbox"/>	PCM	MAP Vacuum	3.01	in Hg
<input type="checkbox"/>	PCM	Throttle Blade Position	15	%
<input type="checkbox"/>	PCM	Vehicle Speed	28.5	MPH
<input type="checkbox"/>	PCM	VVT Oil Pressure	40	psi
<input type="checkbox"/>	PCM	VVT Oil Temp	192	F
<input type="checkbox"/>	PCM	VVT Test Step Count Spec	9	Courts

**2012 Wrangler 3.6
 Decel, accel, light
 cruise**

Control Panel

< Nudge Time : 000.000 Nudge >

-30 30



Event Recording

Template Name : dixon jc vvt test 9 19 12

Total Recording Time : 60

Recording File Comment : dixon 318 4v 12

Vehicle Information

VIN :

Year / Body : 2012JK

Engine : 3.6L

Graph	ECU	Name	Value	Units
<input checked="" type="checkbox"/>	PCM	Engine Speed	6221	rpm
<input type="checkbox"/>	PCM	Exhaust Cam 1 / Crank Difference	-14.0	Engin...
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	112.1	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Desired Position	112.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	35.3879	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 1 Position Error	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 2 Position Error	0.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 / Crank Difference	1.2	Engin...
<input checked="" type="checkbox"/>	PCM	Intake Cam 1 Actual Position	120.3	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Desired Position	119.8	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Intake Cam 1 Position Error	0.5	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Intake Cam 2 Position Error	0.0	Engin...
<input checked="" type="checkbox"/>	PCM	Vehicle Speed	48.0	MPH
<input type="checkbox"/>	PCM	VVT Oil Pressure	148	psi
<input type="checkbox"/>	PCM	VVT Oil Temp	138	F

2012 Avenger 2.4
WOT Run

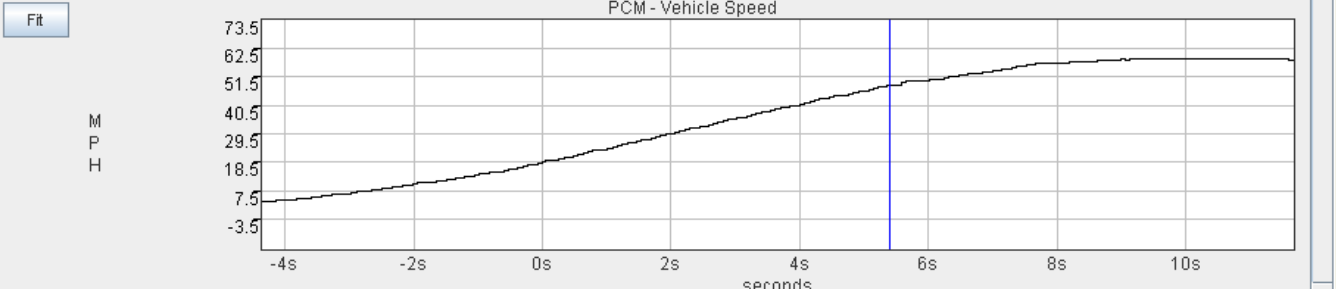
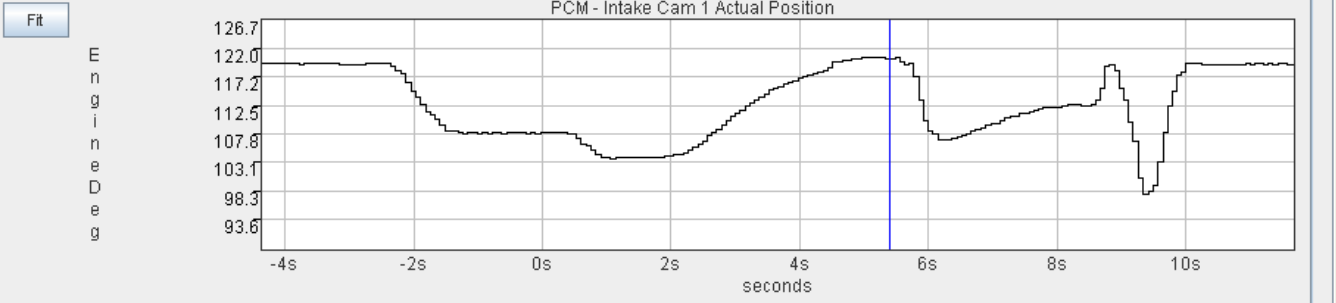
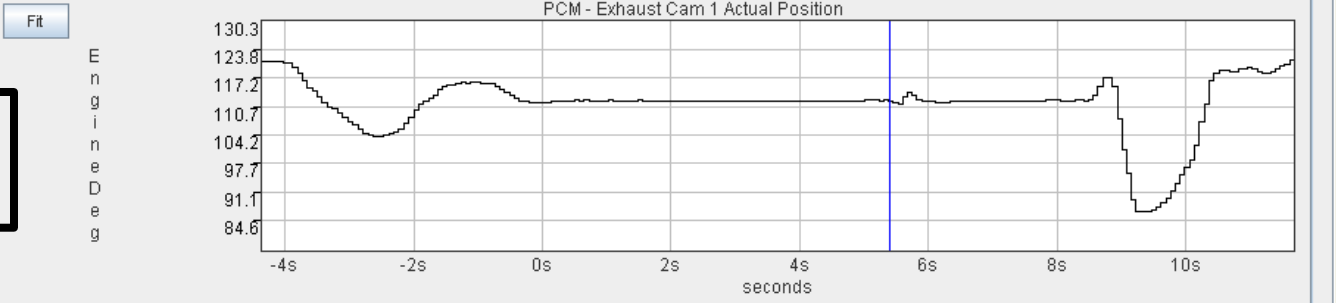
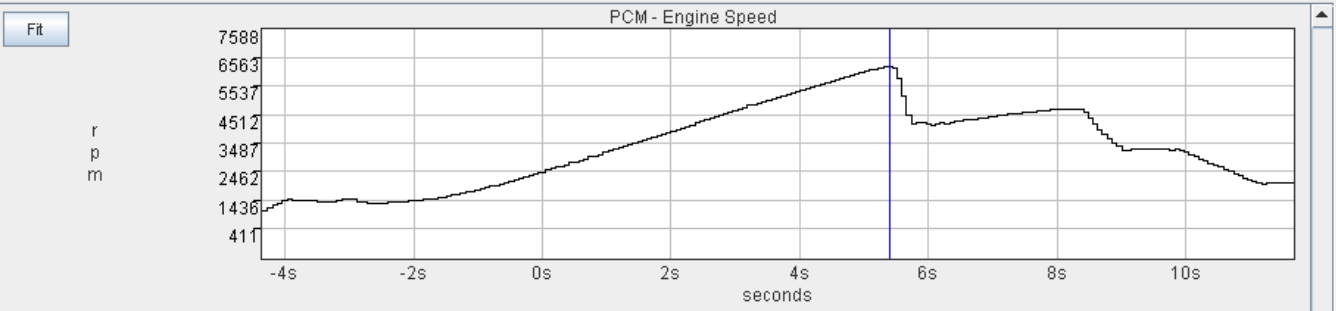
Control Panel

Time: 005.406

< Nudge Nudge >

-30

 30



Select All Deselect All

Event Recording

Template Name : VVT Controls

Total Recording Time : 60

Recording File Comment : vvt78

Vehicle Information

VIN : XXXXXXXXXX

Year / Body : 2012/JS

Engine : 2.4L

Graph	ECU	Name	Value	Units
<input checked="" type="checkbox"/>	PCM	Engine Speed	1999	rpm
<input type="checkbox"/>	PCM	Exhaust Cam 1 / Crank Difference	-28.9	Engin...
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	95.4	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Desired Position	95.4	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	37.8906	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 1 Position Error	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 2 Position Error	0.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 / Crank Difference	17.2	Engin...
<input checked="" type="checkbox"/>	PCM	Intake Cam 1 Actual Position	105.8	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Desired Position	105.8	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Duty Cycle	36.0685	%DC
<input type="checkbox"/>	PCM	Intake Cam 1 Position Error	0.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Intake Cam 2 Position Error	0.0	Engin...
<input checked="" type="checkbox"/>	PCM	Vehicle Speed	56.0	MPH
<input type="checkbox"/>	PCM	VVT Oil Pressure	148	psi
<input type="checkbox"/>	PCM	VVT Oil Temp	153	F

Control Panel

< Nudge Time : 000.000 Nudge >

-30 30

Zoom In Zoom Out GoTo Trigger

**2012 Avenger 2.4
51- 58 MPH cruise**

Select All Deselect All

Event Recording

Template Name : VVT Controls

Total Recording Time : 60

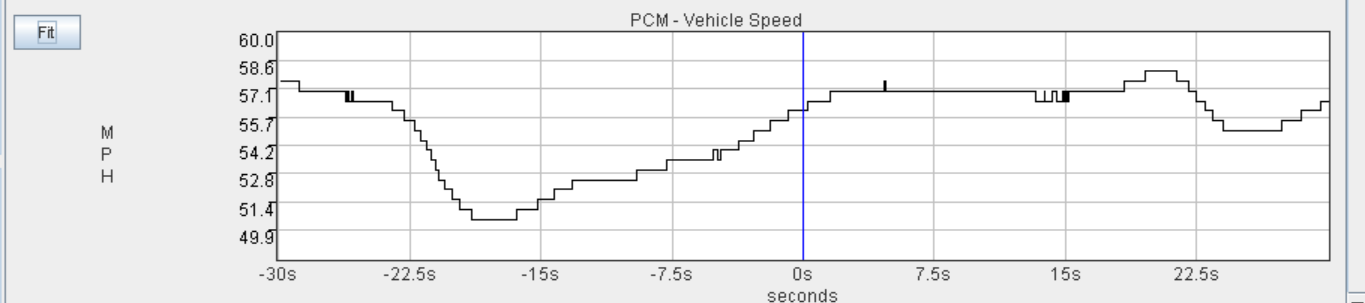
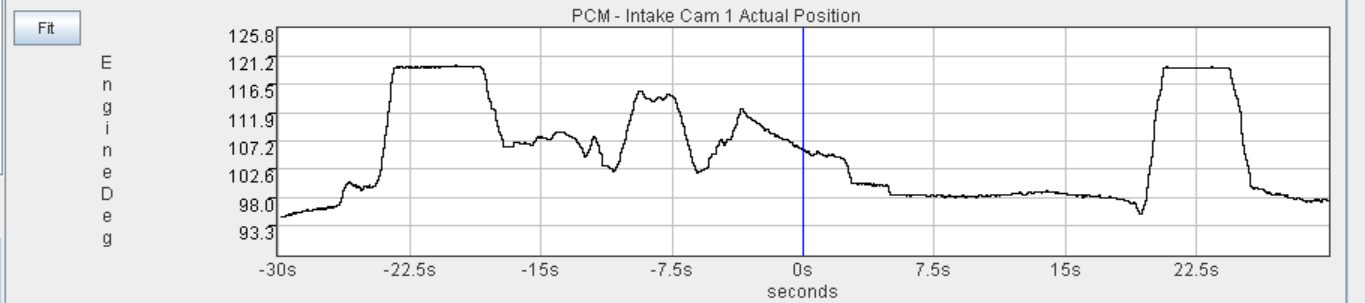
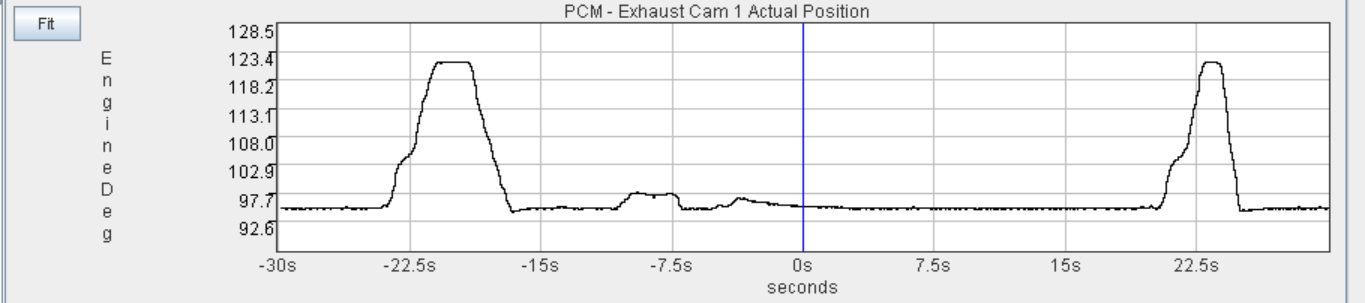
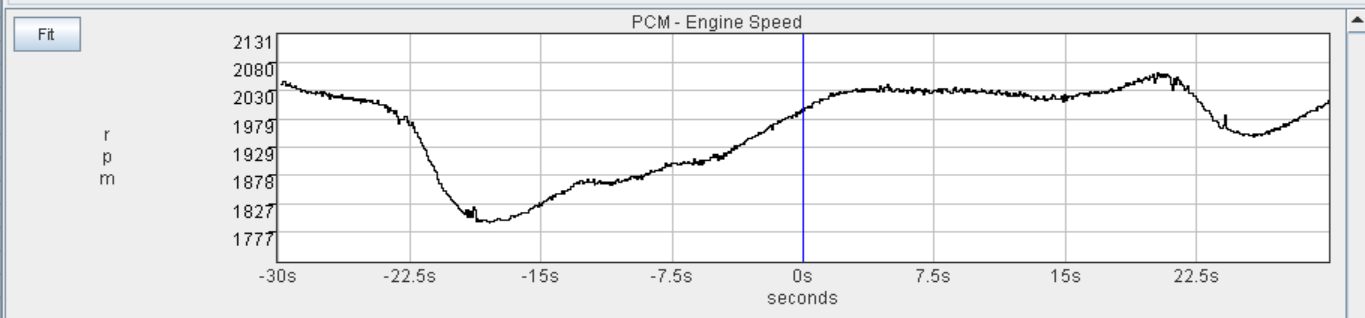
Recording File Comment : vv178

Vehicle Information

VIN : XXXXXXXXXX

Year / Body : 2012/JS

Engine : 2.4L



Graph	ECU	Name	Value	Units
<input checked="" type="checkbox"/>	PCM	Engine Speed	4342	rpm
<input type="checkbox"/>	PCM	Exhaust Cam 1 / Crank Difference	-13.4	Engin...
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	111.9	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Desired Position	111.5	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	35.5070	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 1 Position Error	1.1	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 2 Position Error	0.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 / Crank Difference	13.8	Engin...
<input checked="" type="checkbox"/>	PCM	Intake Cam 1 Actual Position	108.4	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Desired Position	110.6	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Duty Cycle	29.8241	%DC
<input type="checkbox"/>	PCM	Intake Cam 1 Position Error	-2.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Intake Cam 2 Position Error	0.0	Engin...
<input checked="" type="checkbox"/>	PCM	Vehicle Speed	51.0	MPH
<input type="checkbox"/>	PCM	VVT Oil Pressure	148	psi
<input type="checkbox"/>	PCM	VVT Oil Temp	108	F

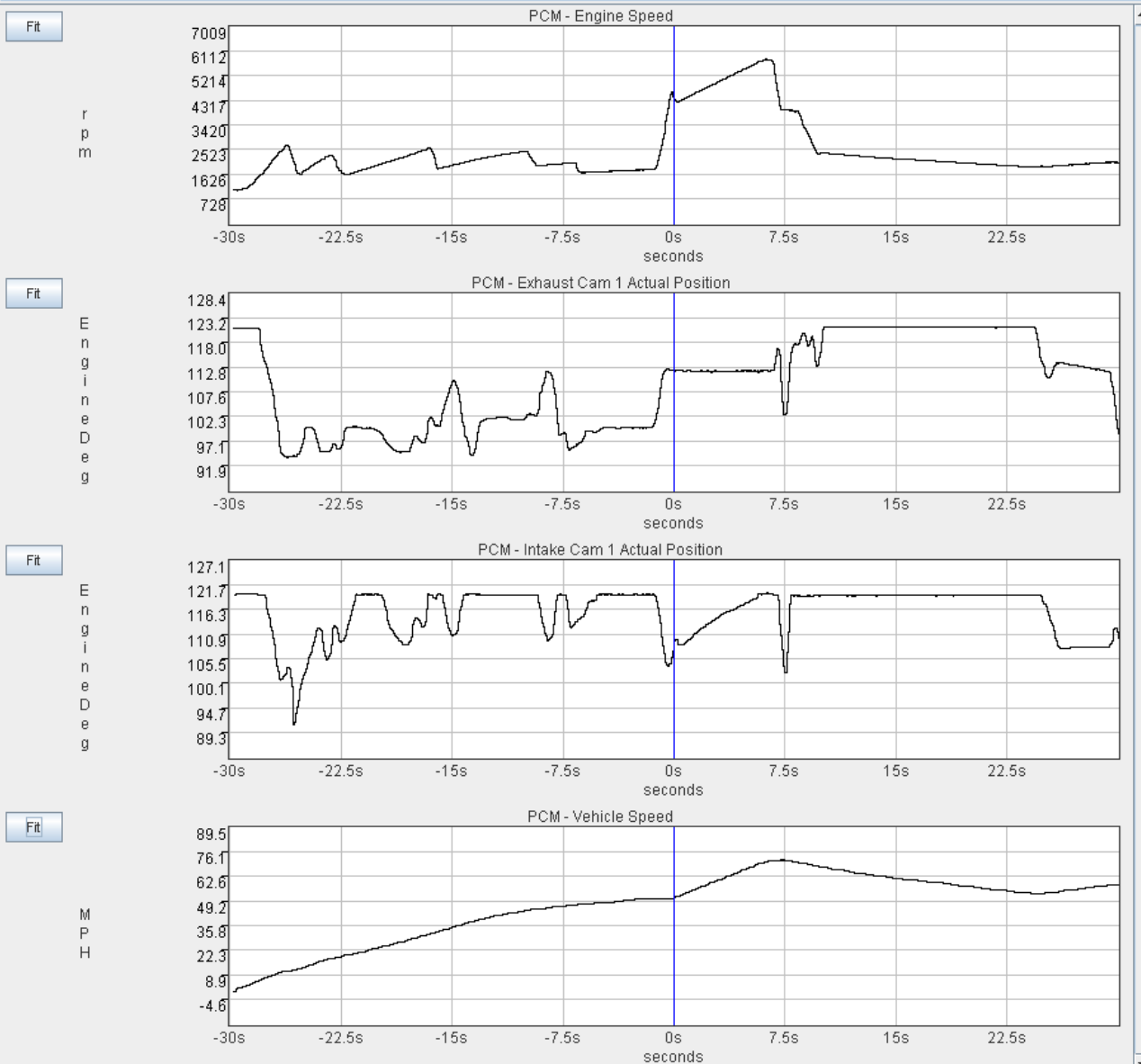
Control Panel

< Nudge Time : 000.000 Nudge >

-30 30

Zoom In Zoom Out GoTo Trigger

2012 Avenger: mild accel, WOT, Decel



Select All Deselect All

Event Recording

Template Name : VVT Controls

Total Recording Time : 60

Recording File Comment : vv178

Vehicle Information

VIN : XXXXXXXXXX

Year / Body : 2012/J5

Engine : 2.4L

Graph	ECU	Name	Value	Units
<input checked="" type="checkbox"/>	PCM	Engine Speed	739	rpm
<input type="checkbox"/>	PCM	Exhaust Cam 1 / Crank Difference	-2.6	Engin...
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	121.3	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Desired Position	120.9	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 1 Position Error	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 2 Position Error	0.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 / Crank Difference	3.9	Engin...
<input checked="" type="checkbox"/>	PCM	Intake Cam 1 Actual Position	119.5	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Desired Position	119.8	Engin...
<input type="checkbox"/>	PCM	Intake Cam 1 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Intake Cam 1 Position Error	0.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Intake Cam 2 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Intake Cam 2 Position Error	0.0	Engin...
<input checked="" type="checkbox"/>	PCM	Vehicle Speed	0.0	MPH
<input type="checkbox"/>	PCM	VVT Oil Pressure	148	psi
<input type="checkbox"/>	PCM	VVT Oil Temp	100	F

Control Panel

< Nudge Time : 005.897 Nudge >

-30 30

Zoom In Zoom Out GoTo Trigger

2012 Avenger 2.4
Coming to/from red
light

Select All Deselect All

Event Recording

Template Name : VVT Controls

Total Recording Time : 60

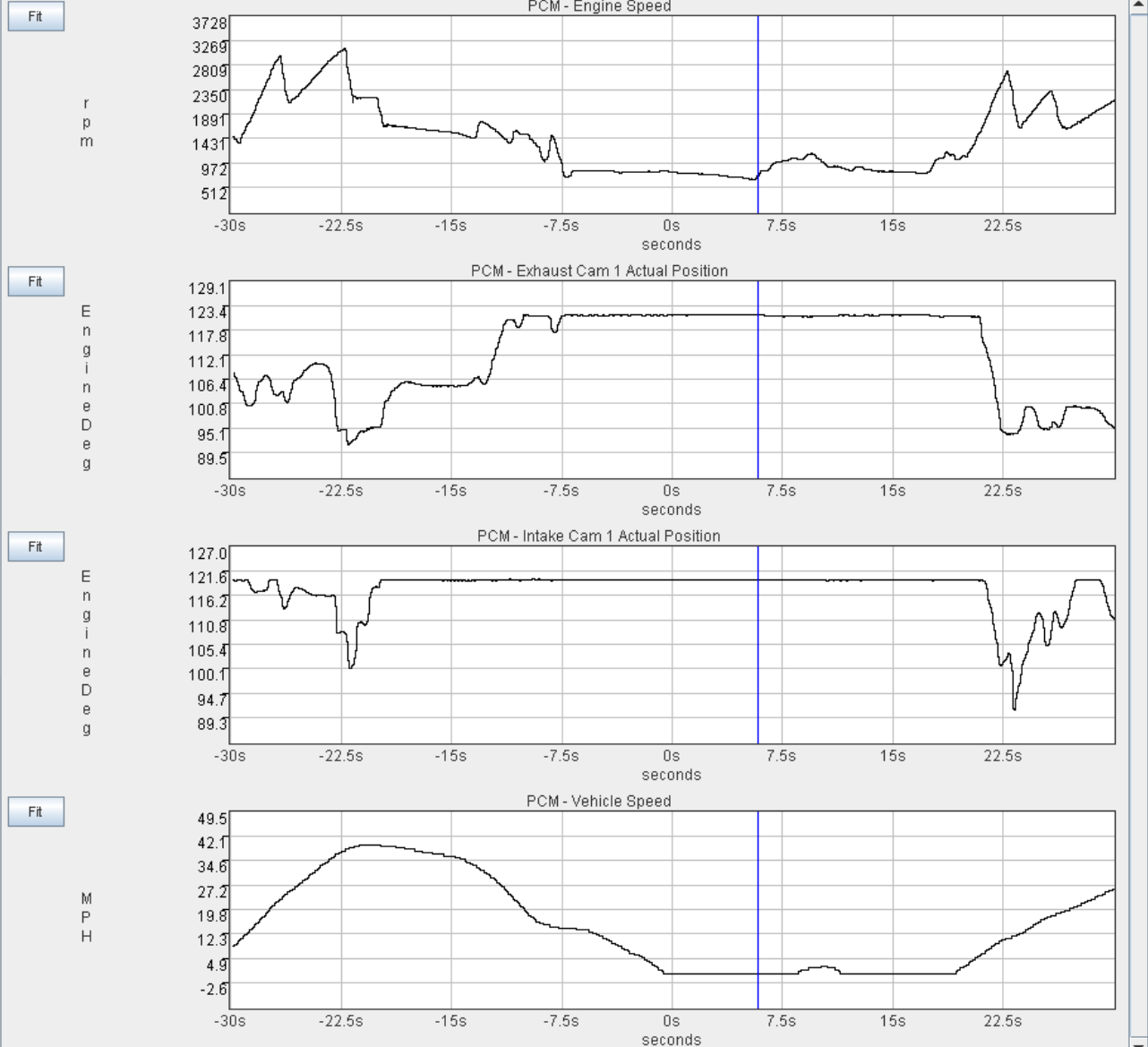
Recording File Comment : vvt78

Vehicle Information

VIN: XXXXXXXXXX

Year / Body : 2012/US

Engine : 2.4L



Graph	ECU	Name	Value	Units
<input type="checkbox"/>	PCM	1/1 O2 Sensor Volts	2.5369	Volts
<input type="checkbox"/>	PCM	2/1 O2 Sensor Volts	2.9670	Volts
<input type="checkbox"/>	PCM	Actual Torque	92.60	Ft-Lbs
<input checked="" type="checkbox"/>	PCM	Engine Speed	2307	rpm
<input type="checkbox"/>	PCM	Exhaust Cam 1 / Crank Difference	-35.8	Engin...
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	87.6	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Desired Position	89.8	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	45.2093	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 1 Position Error	-2.1	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Actual Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Position Error	0.0	Engin...
<input checked="" type="checkbox"/>	PCM	MAP Vacuum	14.93	in Hg
<input type="checkbox"/>	PCM	Spark Advance	26.5	Engin...
<input type="checkbox"/>	PCM	Spark Advance 1	-37.5	degr...
<input type="checkbox"/>	PCM	ST Knock Retard	0.0	degr...
<input type="checkbox"/>	PCM	Throttle Blade Position	14	%
<input type="checkbox"/>	PCM	TPS 1 Volts	1.2273	Volts
<input checked="" type="checkbox"/>	PCM	Vehicle Speed	33.0	MPH

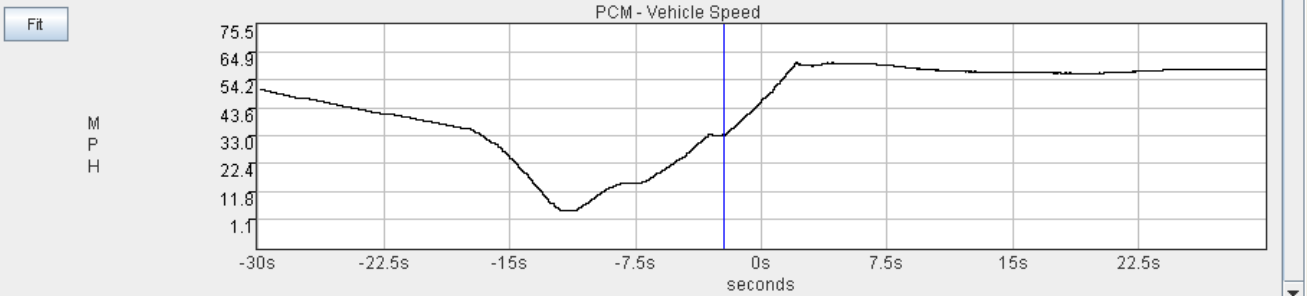
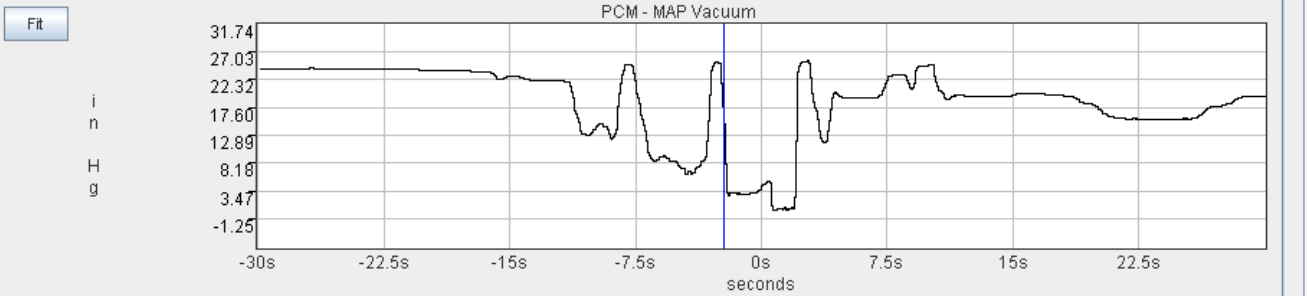
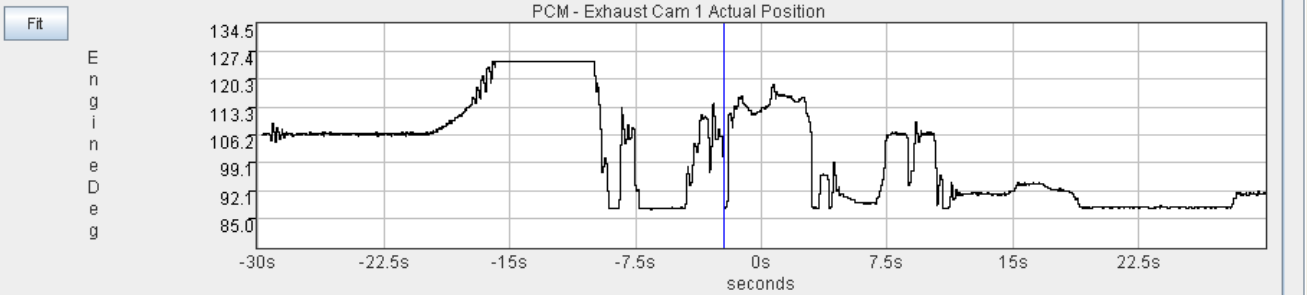
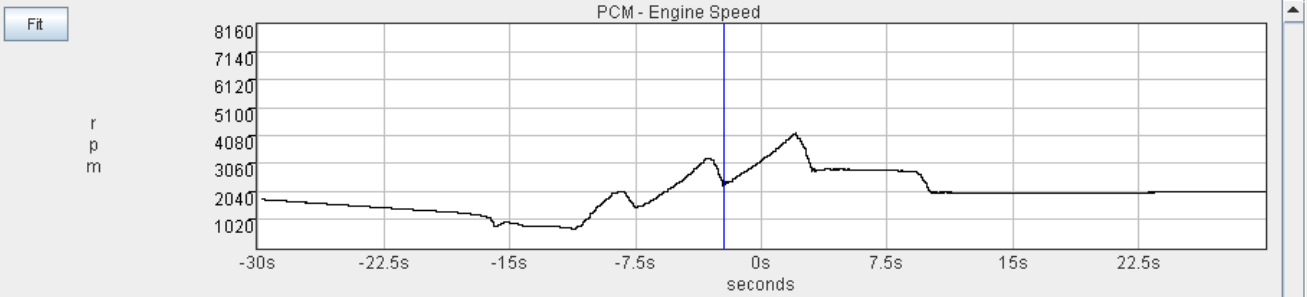
Control Panel

< Nudge Time: -002.226 Nudge >

-30 30

Zoom In Zoom Out GoTo Trigger

'12 Challenger 5.7
 moderate decel,
 moderate accel,
 cruise



Select All Deselect All

Event Recording

Template Name : lc dixon vvt experiment

Total Recording Time : 60

Recording File Comment : VVT experiments on 5.7 LC 6 speed

Vehicle Information

VIN :

Year / Body : 2012LC

Engine : 5.7L

Graph	ECU	Name	Value	Units
<input type="checkbox"/>	PCM	1/1 O2 Sensor Volts	3.3385	Volts
<input type="checkbox"/>	PCM	2/1 O2 Sensor Volts	2.6688	Volts
<input type="checkbox"/>	PCM	Actual Torque	78.32	Ft-Lbs
<input checked="" type="checkbox"/>	PCM	Engine Speed	2070	rpm
<input type="checkbox"/>	PCM	Exhaust Cam 1 / Crank Difference	-35.6	Engin...
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	87.7	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Desired Position	87.9	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	40.1765	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 1 Position Error	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Actual Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Position Error	0.0	Engin...
<input checked="" type="checkbox"/>	PCM	MAP Vacuum	16.58	in Hg
<input type="checkbox"/>	PCM	Spark Advance	28.5	Engin...
<input type="checkbox"/>	PCM	Spark Advance 1	-35.5	degr...
<input type="checkbox"/>	PCM	ST Knock Retard	0.0	degr...
<input type="checkbox"/>	PCM	Throttle Blade Position	9	%
<input type="checkbox"/>	PCM	TPS 1 Volts	0.9479	Volts
<input checked="" type="checkbox"/>	PCM	Vehicle Speed	59.5	MPH

**'12 Challenger 5.7
57-60 MPH Cruise**

Select All Deselect All

Event Recording

Template Name : lc dixon vvt experiment

Total Recording Time : 60

Recording File Comment : VVT experiments on 5.7 LC 6 speed

Vehicle Information

VIN : XXXXXXXXXX

Year / Body : 2012/LC

Engine : 5.7L

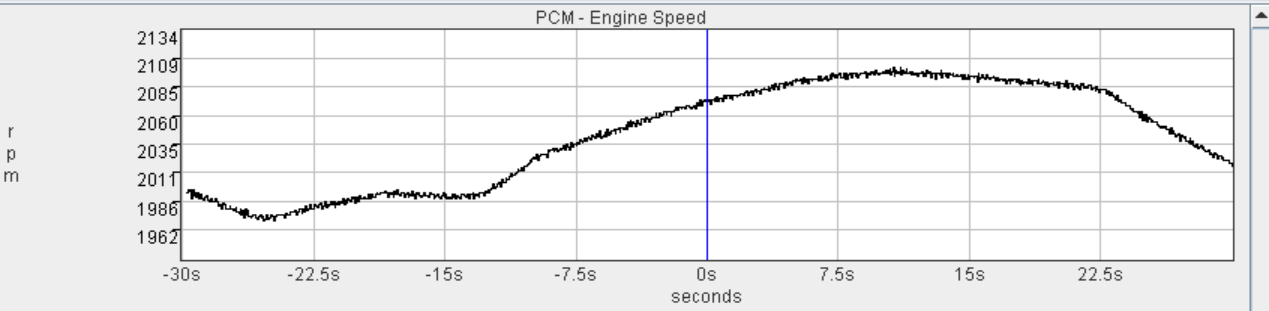
Control Panel

< Nudge Time : 000.000 Nudge >

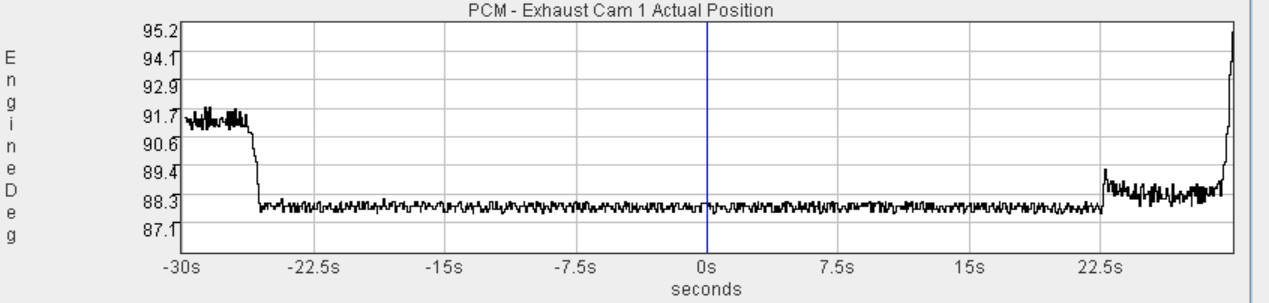
-30 30

Zoom In Zoom Out GoTo Trigger

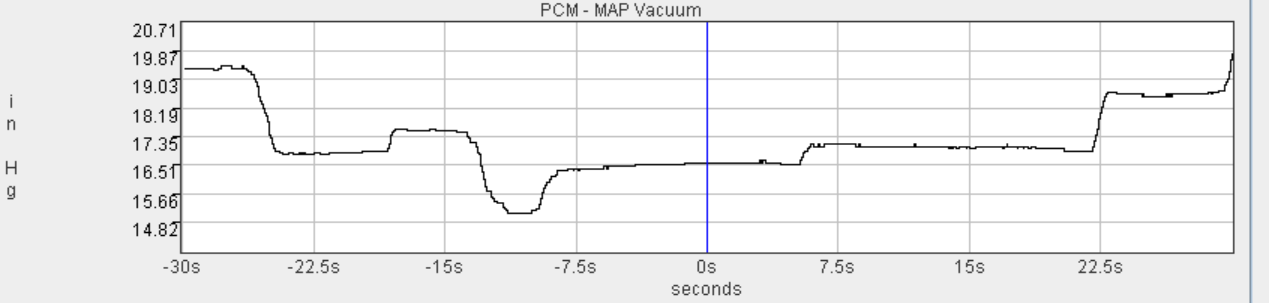
Fit



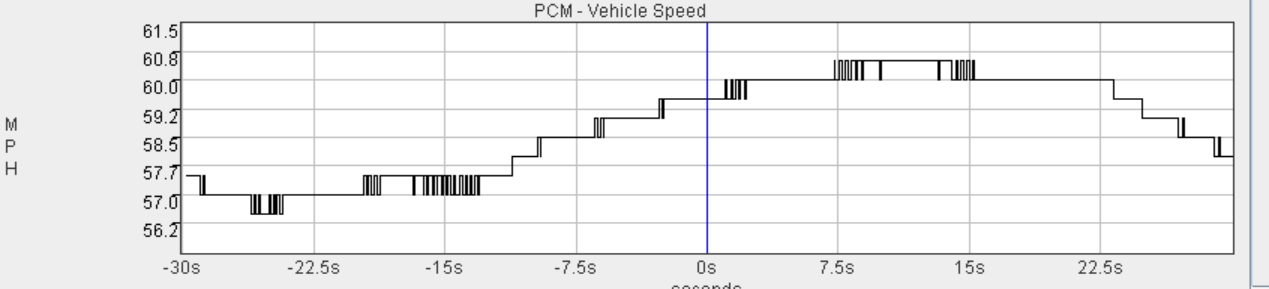
Fit



Fit



Fit



Graph	ECU	Name	Value	Units
<input type="checkbox"/>	PCM	1/1 O2 Sensor Volts	3.4265	Volts
<input type="checkbox"/>	PCM	2/1 O2 Sensor Volts	3.4216	Volts
<input type="checkbox"/>	PCM	Actual Torque	279.85	Ft-Lbs
<input checked="" type="checkbox"/>	PCM	Engine Speed	5636	rpm
<input type="checkbox"/>	PCM	Exhaust Cam 1 / Crank Difference	-13.3	Engin...
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	110.1	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Desired Position	109.4	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	46.5064	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 1 Position Error	0.6	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Actual Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Position Error	0.0	Engin...
<input checked="" type="checkbox"/>	PCM	MAP Vacuum	1.00	in Hg
<input type="checkbox"/>	PCM	Spark Advance	17.5	Engin...
<input type="checkbox"/>	PCM	Spark Advance 1	-46.5	degr...
<input type="checkbox"/>	PCM	ST Knock Retard	0.0	degr...
<input type="checkbox"/>	PCM	Throttle Blade Position	37	%
<input type="checkbox"/>	PCM	TPS 1 Volts	2.1362	Volts
<input checked="" type="checkbox"/>	PCM	Vehicle Speed	57.5	MPH

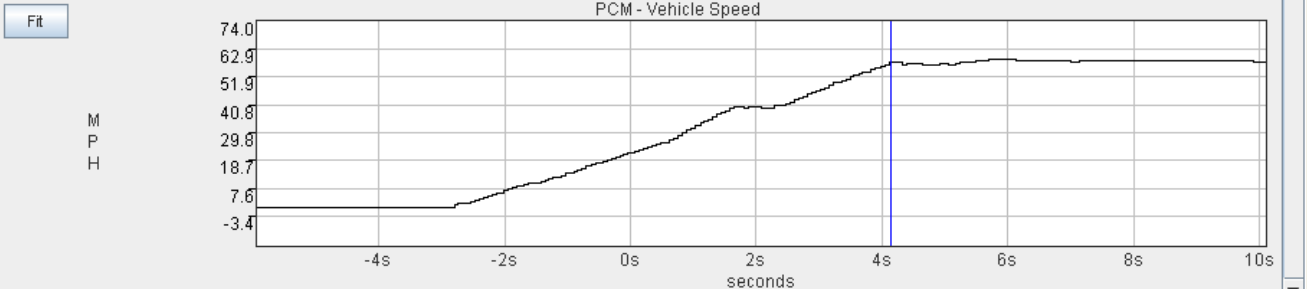
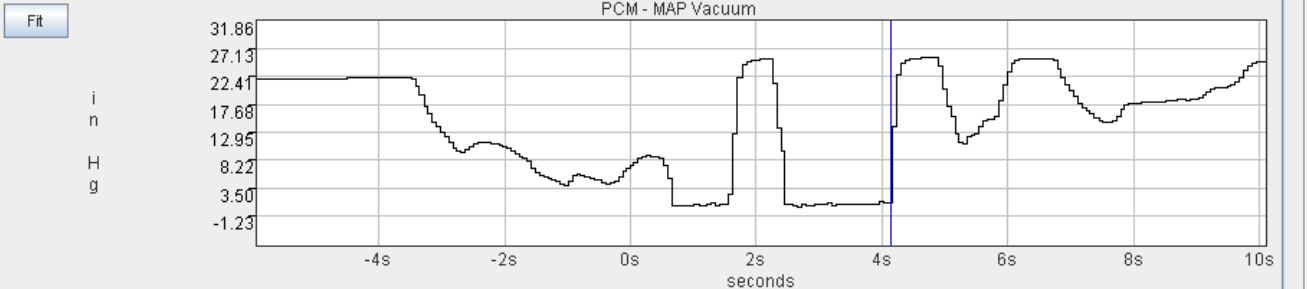
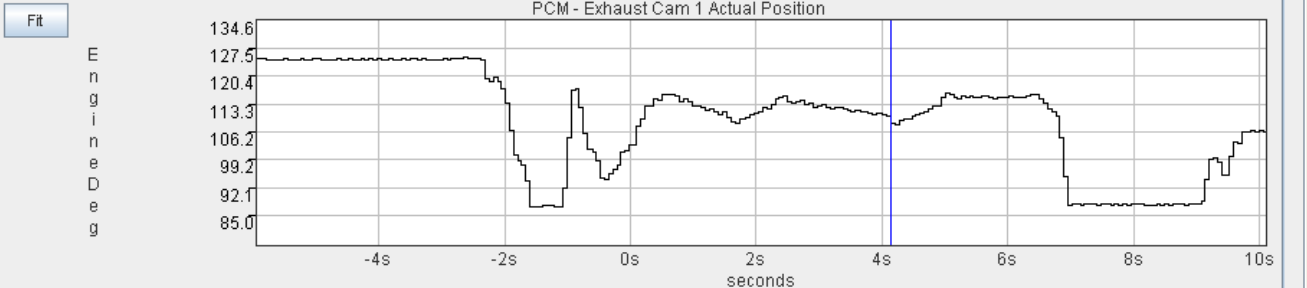
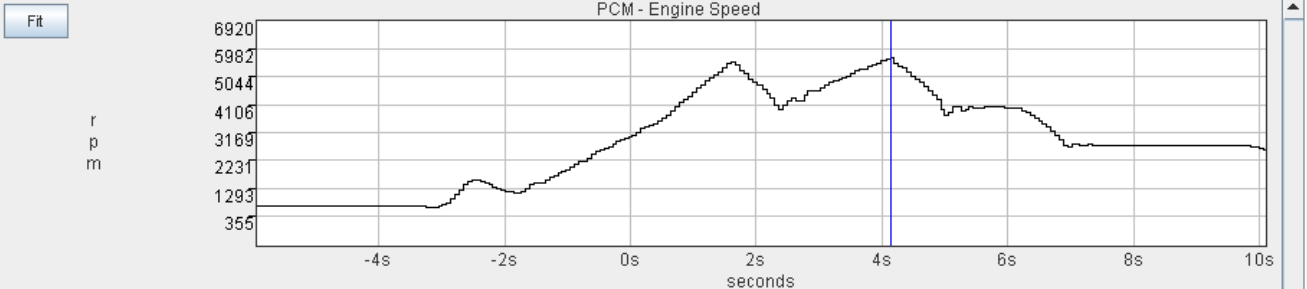
Control Panel

< Nudge Time : 004.134 Nudge >

-30 | 30

Zoom In Zoom Out GoTo Trigger

'12 Challenger 5.7
Spirited accel with slow
1-2 shift



Select All Deselect All

Event Recording

Template Name : lc dixon vvt experiment

Total Recording Time : 60

Recording File Comment : VVT experiments on 5.7 LC 6 speed

Vehicle Information

VIN : XXXXXXXXXX

Year / Body : 2012LC

Engine : 5.7L

Graph	ECU	Name	Value	Units
<input type="checkbox"/>	PCM	1/1 O2 Sensor Volts	3.3141	Volts
<input type="checkbox"/>	PCM	2/1 O2 Sensor Volts	3.3238	Volts
<input type="checkbox"/>	PCM	Actual Torque	-1.24	ft-Lbs
<input checked="" type="checkbox"/>	PCM	Engine Speed	702	rpm
<input type="checkbox"/>	PCM	Exhaust Cam 1 / Crank Difference	1.0	Engin...
<input checked="" type="checkbox"/>	PCM	Exhaust Cam 1 Actual Position	124.7	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Desired Position	124.9	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 1 Duty Cycle	0.0000	%DC
<input type="checkbox"/>	PCM	Exhaust Cam 1 Position Error	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Actual Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Desired Position	0.0	Engin...
<input type="checkbox"/>	PCM	Exhaust Cam 2 Position Error	0.0	Engin...
<input checked="" type="checkbox"/>	PCM	MAP Vacuum	22.48	in Hg
<input type="checkbox"/>	PCM	Spark Advance	15.5	Engin...
<input type="checkbox"/>	PCM	Spark Advance 1	-48.5	degr...
<input type="checkbox"/>	PCM	ST Knock Retard	0.0	degr...
<input type="checkbox"/>	PCM	Throttle Blade Position	2	%
<input type="checkbox"/>	PCM	TPS 1 Volts	0.5978	Volts
<input checked="" type="checkbox"/>	PCM	Vehicle Speed	0.0	MPH

'12 Challenger 5.7
 Idle at red light

Select All Deselect All

Event Recording

Template Name : lc dixon vvt experiment

Total Recording Time : 60

Recording File Comment : VVT experiments on 5.7 LC 6 speed

Vehicle Information

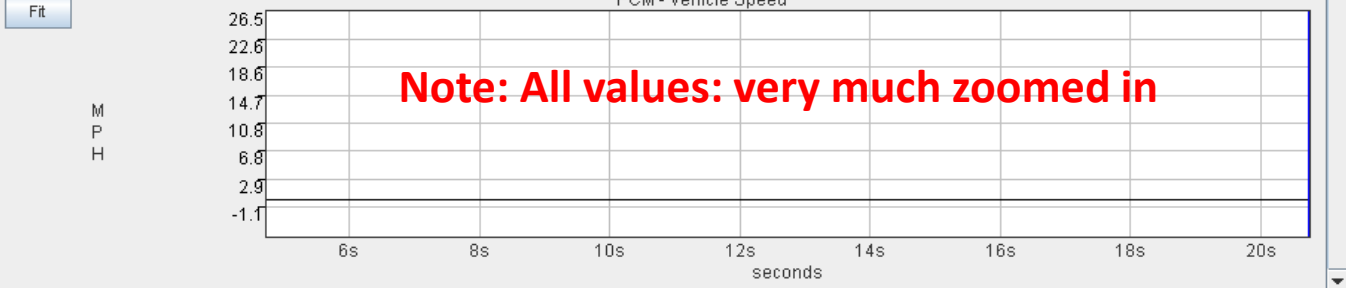
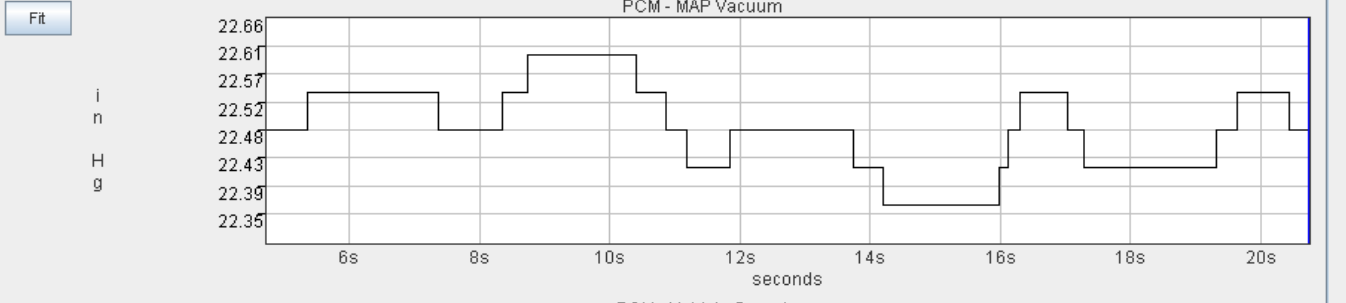
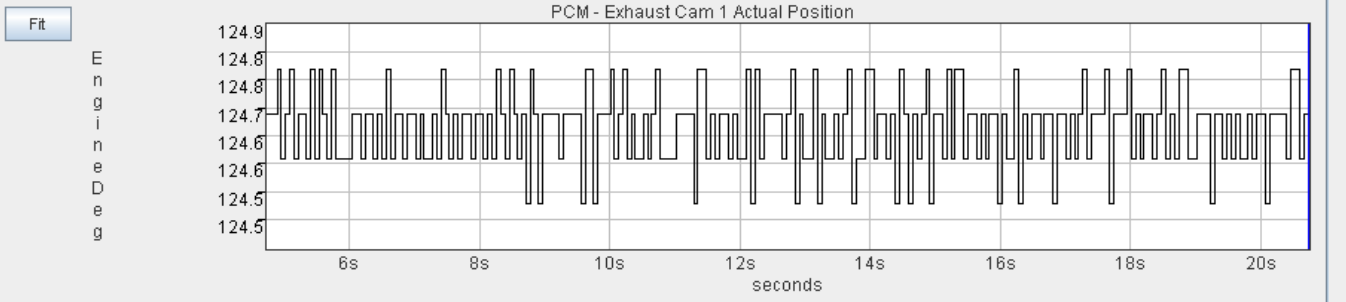
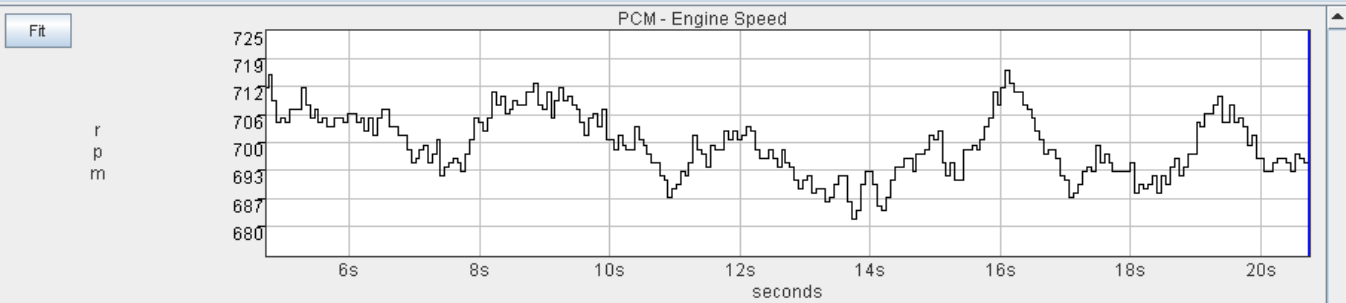
VIN [REDACTED]

Year / Body : 2012LC

Engine : 5.7L

Control Panel

Time : 020.742



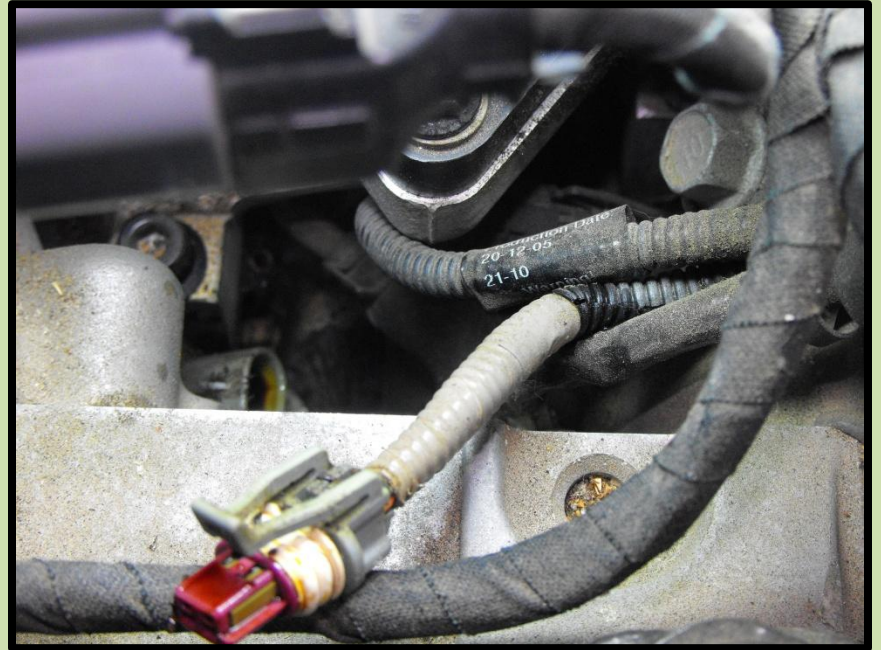
Note: All values: very much zoomed in

Phaser Style: Troubleshooting

- P0010
- P0013
- Cam Actuator circuit open
- Electrical issue: measure solenoid resistance, measure voltage on wires, check connections



Phaser Style: Troubleshooting



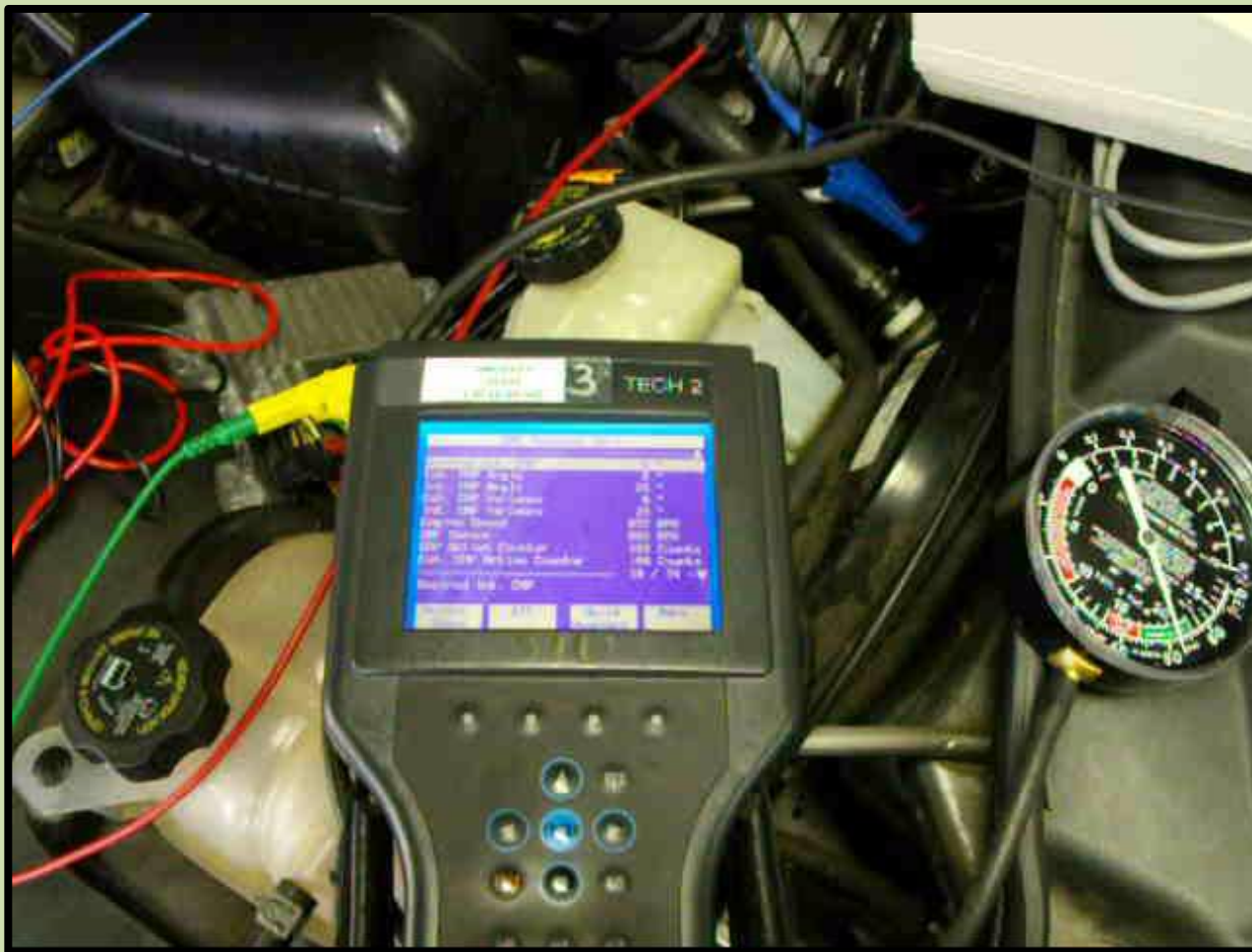
VVT solenoid from '06 Kia Sedona 3.8;
leaking oil within solenoid caused a P0010

Phaser Style: Troubleshooting

- P000A
- P000B
- Cam A or B slow Response
- P0011
- P0014
- Cam A or B target performance



Phaser Style: Troubleshooting



2307 intake variance video clip

Phaser Style: Troubleshooting

1. Oil level correct?
2. Oil reasonably clean?
3. Correct oil viscosity?
4. Factory Oil Filter?
5. Solenoid correct resistance?
6. Can PCM actuate solenoid?
7. Clogged oil screen(s)
8. Cam Timing correct?

Phaser Style: Troubleshooting

12.02.15

Utilities Reports Monitors Preferences About Help

Search Service Information Enter search phrase here

PCM View

Click on tabs to access various ECU operations and information for the selected ECU.

Flash Data DTCs Actuators System Tests Misc Functions ECU Details

Double-click row selection to launch misc function. Click on column heading to sort table.

Name
Check PCM VIN
Intake Phaser 1 Cleaning
Exhaust Phaser 1 Cleaning
Exhaust Phaser 2 Cleaning
Intake Phaser 2 Cleaning
Midtronics Warranty Code Validation
Enable Emissions Rolls Test Mode (TIPM)
Check PCM Odometer
Cam Crank Relearn
Reset Memory
Learn ETC
QuickLearn (Non-RFE)
TCC Break-In (Non-RFE)
New Engine Installed

Overview

Name:
Powertrain Control Module

Flash Part Number:
68139871AC

Bus Type:
CAN C

Hardware Version:
12.47

Software Version:
10.00.00

Original VIN
2C3CDYBT2CH148100

Current VIN
2C3CDYBT2CH148100

Variant & Version:
23 - A4

Country Code
USA

DTC Count:
0

(4) New knowledge base articles Login Off-line Disconnect Warnings: 0 Errors: 0

Phaser cleaning mode
with scan tool

Phaser Style: Troubleshooting

The screenshot shows a scan tool interface with a 'VVT System Test' dialog box open. The dialog box displays the following table:

Name	Value	Unit
Exhaust Cam 1 Desired Position	124.8	EngineDeg
Exhaust Cam 1 Actual Position	124.7	EngineDeg
Exhaust Cam 1 Position Error	0.0	EngineDeg
VVT Test Step Count Spec	9	Counts
VVT Test Step Timer Spec	5.0	seconds

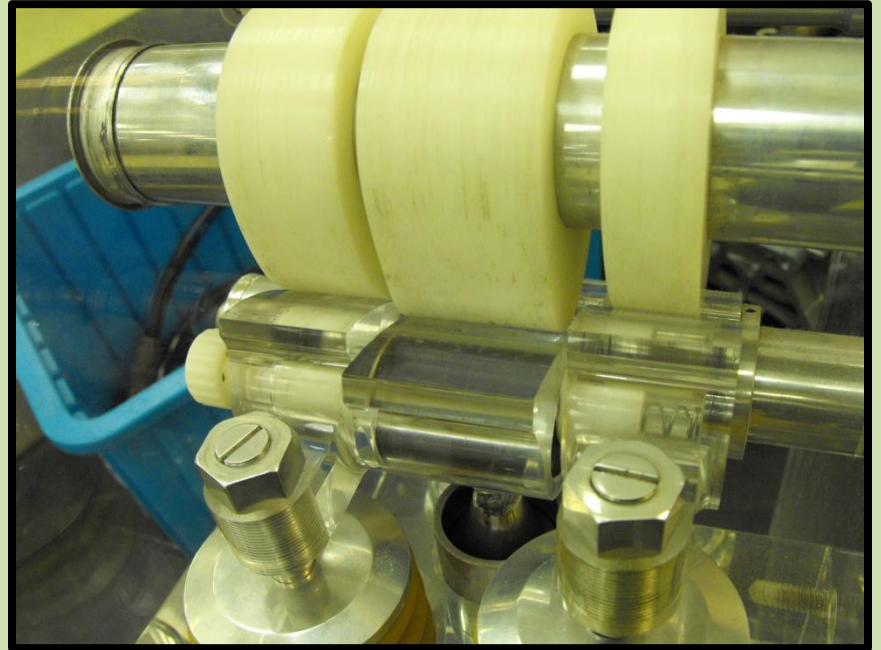
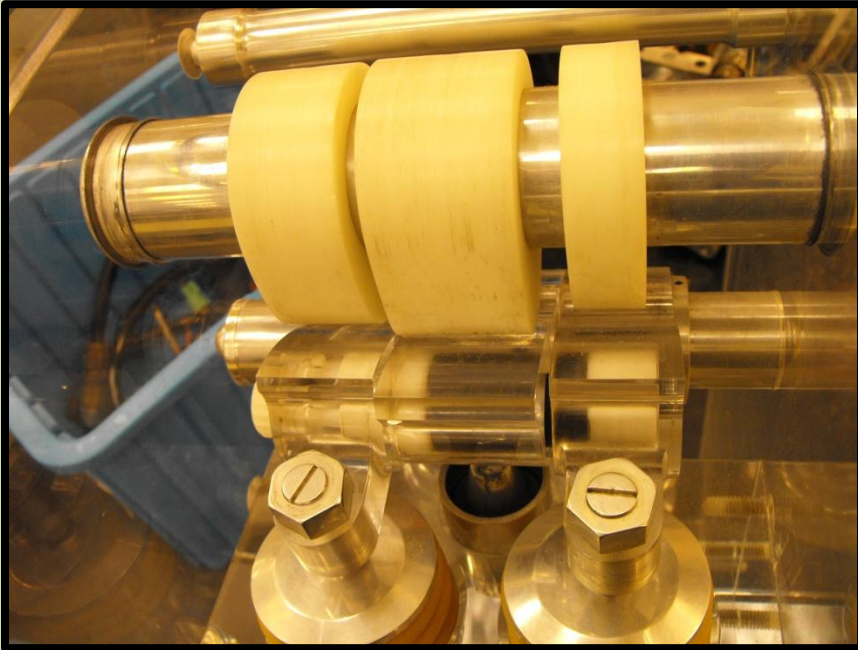
A large text box with a black border is overlaid on the table, containing the text 'Scan Tool System Test'.

The background interface includes a menu bar (Utilities, Reports, Monitors, Preferences, About, Help), a search bar, and a 'PCM View' section with tabs for Flash, Data, DTCs, Actuators, System Tests, Misc Functions, and ECU Details. The 'System Tests' tab is active, showing a list of test items including VVT System.

Lobe Switching Style

- Use of different cam lobes to control valves
Mitsubishi **MIVEC** and Honda **VTEC**
- Use a solenoid to move a hydraulic valve and direct oil through rocker shaft to a piston on the rocker arm to connect or disconnect arms
- May be combined with phaser style (**I-VTEC**)

Lobe Switching Style

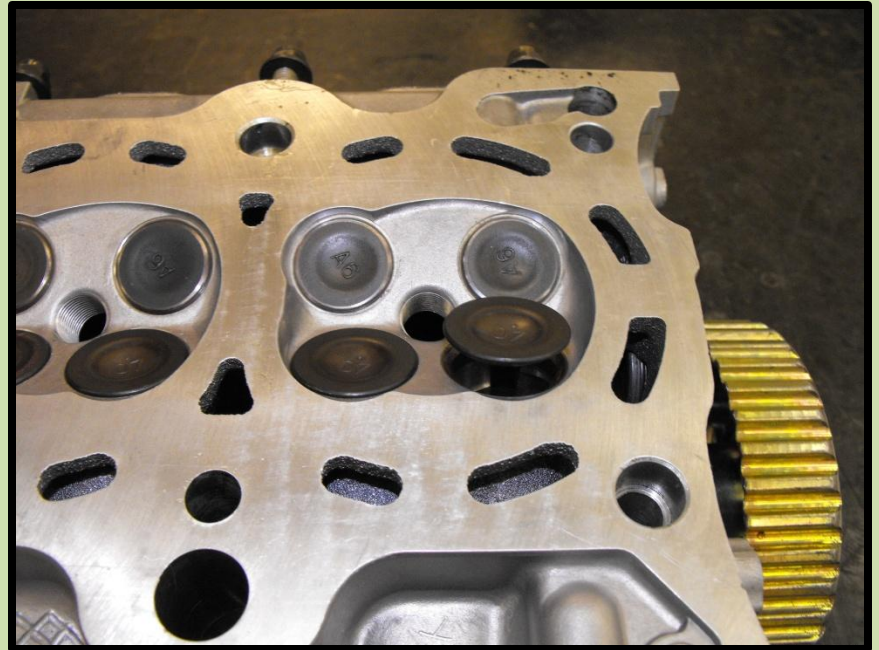


Honda VTEC mock up: depicts rockers connecting/
disconnecting

Lobe Switching Style

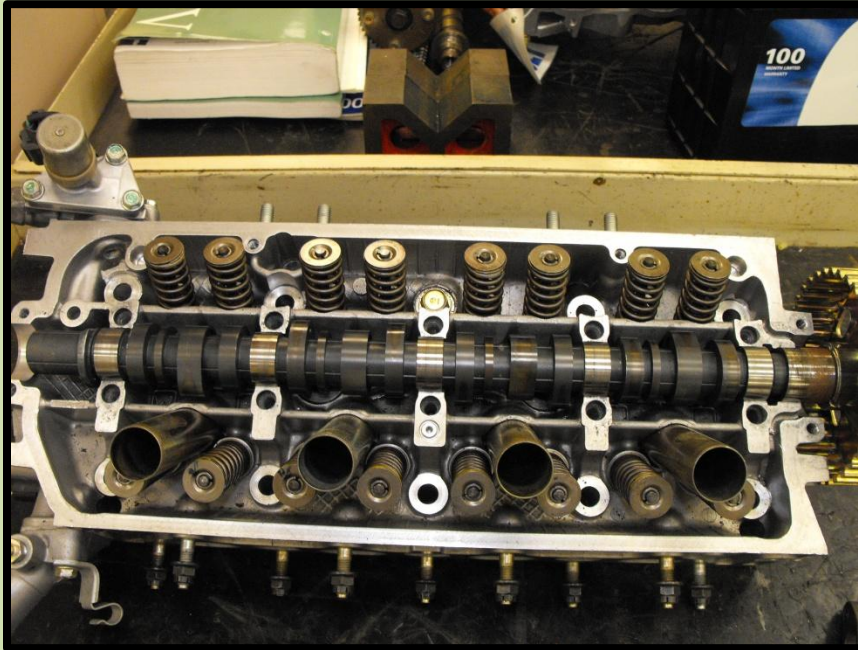
There are many VTEC versions, used to:

- Improve swirl
- Improve economy
- Deactivate cylinders (VCM)
- Improve high end power

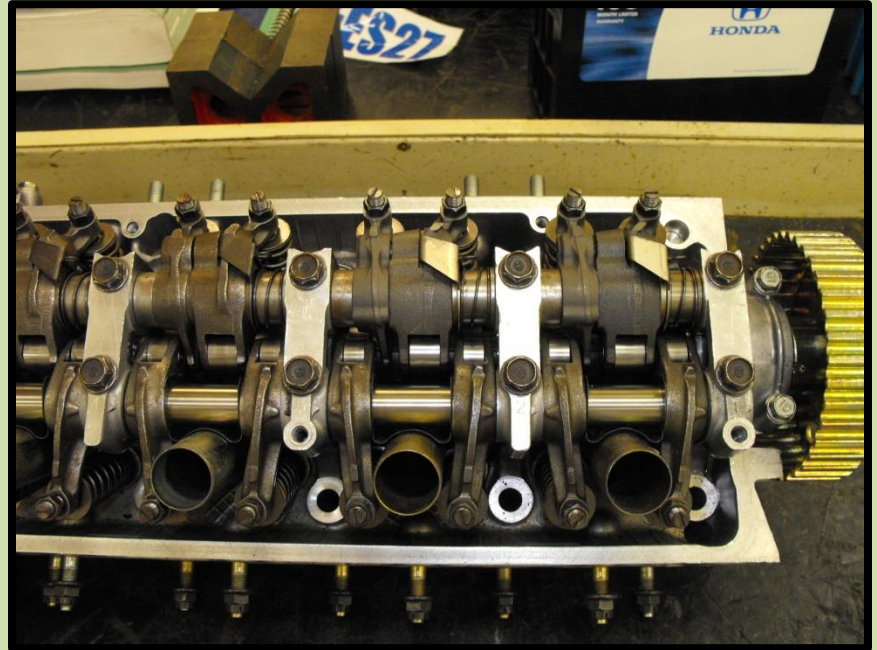


4 valve head, one intake
nearly closed, improves
low RPM swirl

Lobe Switching Style

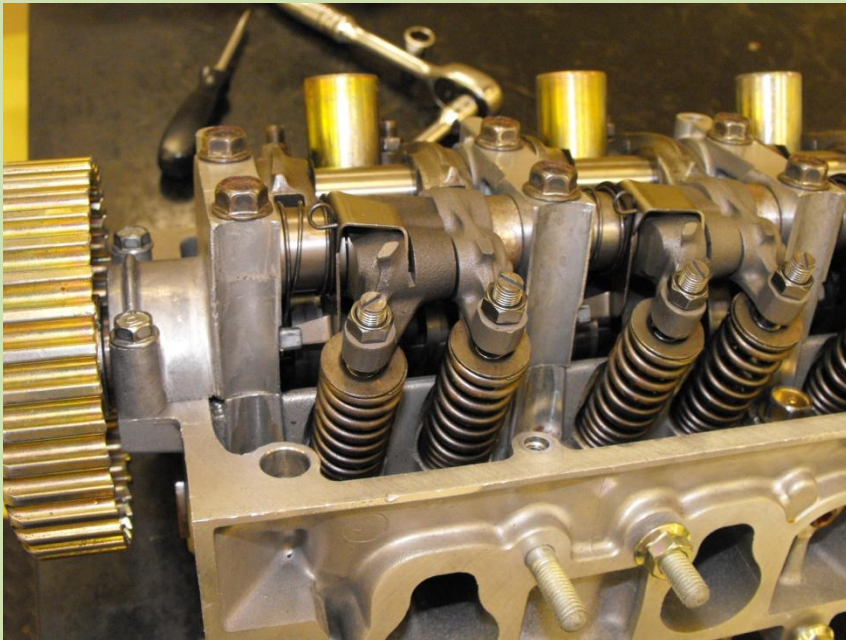


Camshaft: note multiple lobes



On this "D" series, VTEC intake only: note rockers towards top

Lobe Switching Style

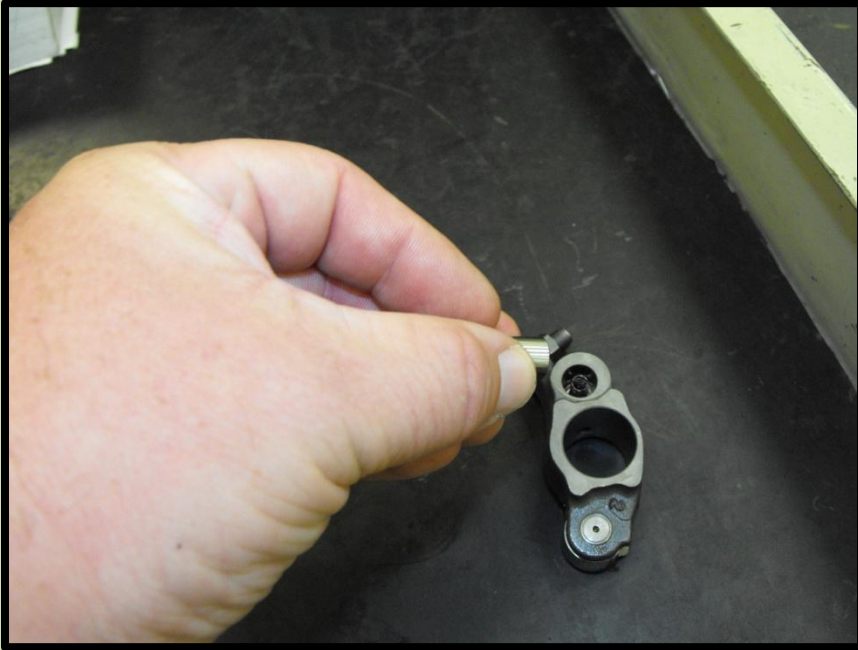


VTEC on intake, note:
adjustable valves



Rockers shafts: oil passage
holes

Lobe Switching Style

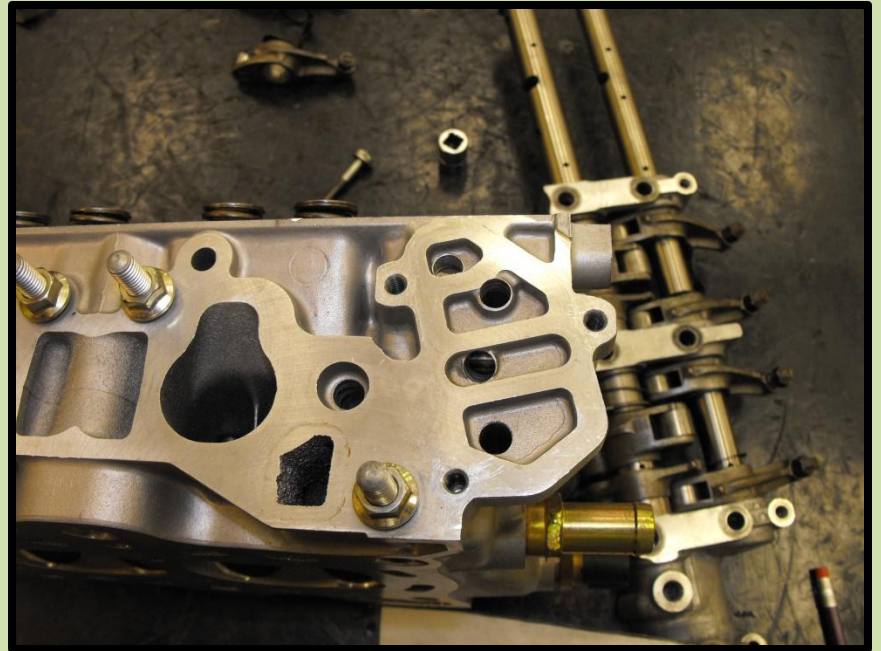


Rockers for the intake valves, lock pin, spring, timing piston

Lobe Switching Style



Oil control solenoid & pressure switch



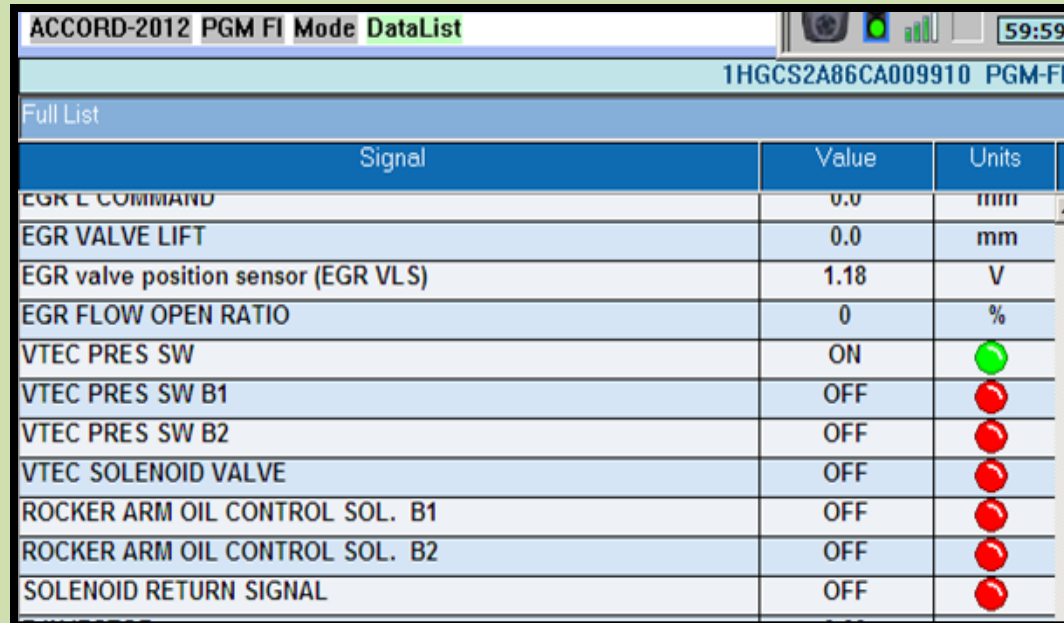
Head casting with oil passages to solenoid assembly

Lobe Switching Style








- Using shop air to test VTEC hydraulic system
- Test the rockers to make sure they are locked together
- One oil passage plugged: blue tool



Lobe Switching Style

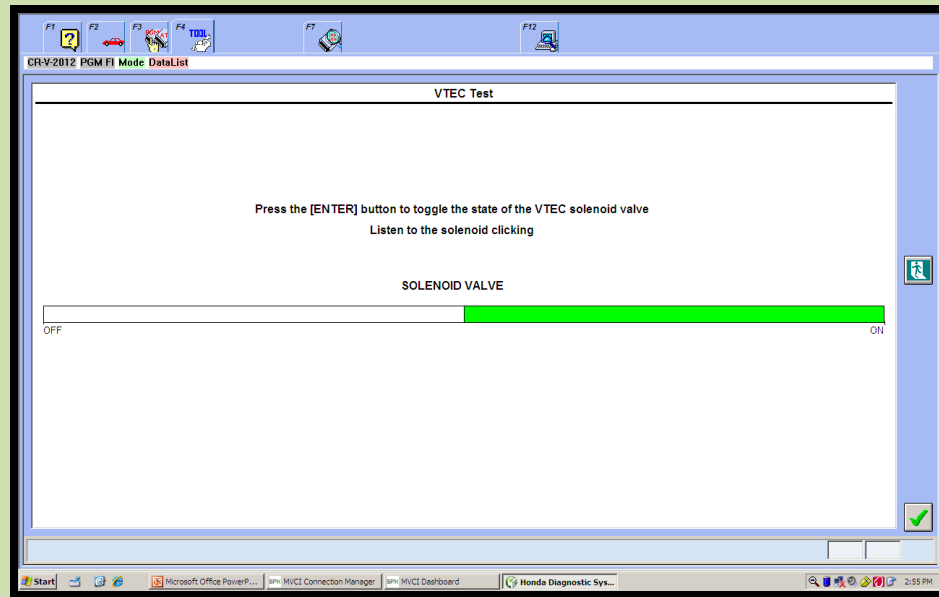
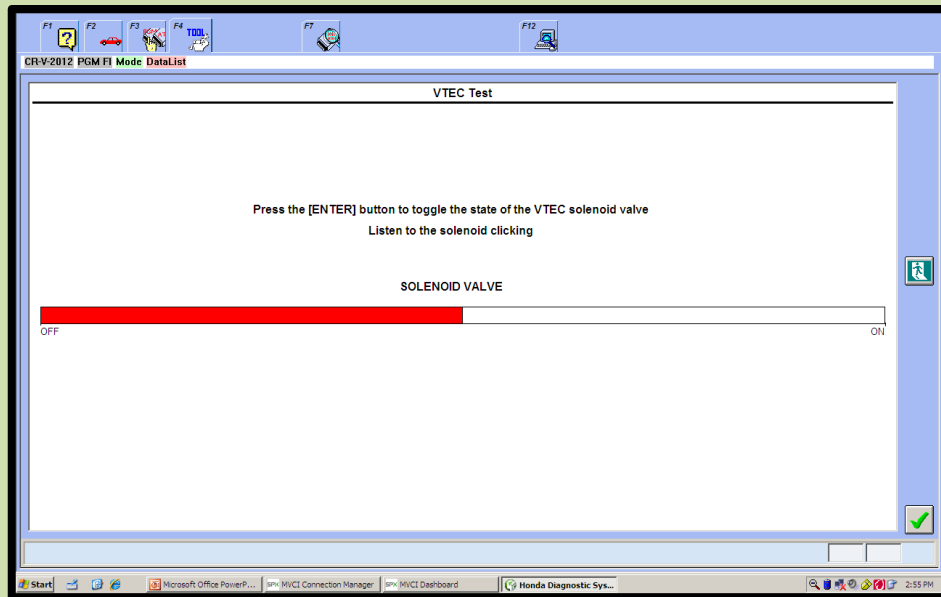


The screenshot shows a scan tool interface for an ACCORD-2012 PGM FI. The 'DataList' mode is active, displaying a table of engine parameters. The vehicle ID is 1HGCS2A86CA009910. The table lists various signals, their current values, and units. The 'VTEC PRES SW' signal is ON, indicated by a green light, while all other signals are OFF, indicated by red lights.

Signal	Value	Units
EGR COMMAND	0.0	mm
EGR VALVE LIFT	0.0	mm
EGR valve position sensor (EGR VLS)	1.18	V
EGR FLOW OPEN RATIO	0	%
VTEC PRES SW	ON	
VTEC PRES SW B1	OFF	
VTEC PRES SW B2	OFF	
VTEC SOLENOID VALVE	OFF	
ROCKER ARM OIL CONTROL SOL. B1	OFF	
ROCKER ARM OIL CONTROL SOL. B2	OFF	
SOLENOID RETURN SIGNAL	OFF	

Honda MVCI Scan tool Data List showing solenoid control and oil pressure switch status

Lobe Switching style



Inspection mode: actuate the VTEC solenoid

Lobe Switching Style

The screenshot displays the SPX MVCI Dashboard software. The top menu bar includes F1 (Help), F2 (Vehicle), F3 (DTC), F4 (TOOL), and F5 (DTC). The main window is titled "DTC Monitor Tool" and shows an "Inspection Menu" on the left with the following options: EVAP TEST, EGR TEST, **VTEC TEST** (highlighted), ETCS (TAC) TEST, RADIATOR FAN, A/C CLUTCH, FUEL PUMP ON, FUEL PUMP OFF, ALL INJECTORS STOP, ONE INJECTOR STOP, CRUISE CONTROL CANCEL HISTORY, and IDLE STOP STARTER COUNTER CHECK.

The right pane displays the "VTEC TEST" procedure:

Vehicles equipped with the VTEC oil pressure switch:
Activates the VTEC solenoid valve and monitors the input signal from the VTEC oil pressure switch against ECM/PCM command.
At first, checks solenoid valve OFF. At this time, it is normal if VTEC oil pressure switch shows ON against solenoid commanded OFF. Next turns solenoid ON. It is normal if it shows OFF against solenoid commanded ON.

The diagram shows two waveforms over time (T). The top waveform (blue) represents the VTEC solenoid command, which transitions from OFF (B) to ON (A). The bottom waveform (red) represents the VTEC oil pressure switch, which transitions from ON (A) to OFF (B) at the same time as the solenoid command.

Legend:
--- VTEC solenoid command
--- VTEC oil pressure switch
A : ON
B : OFF
T : Time

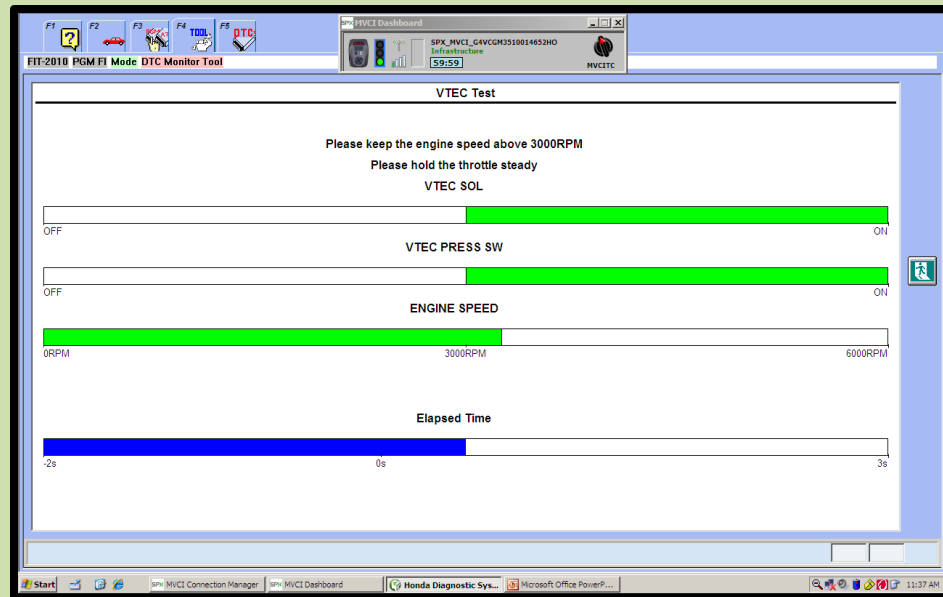
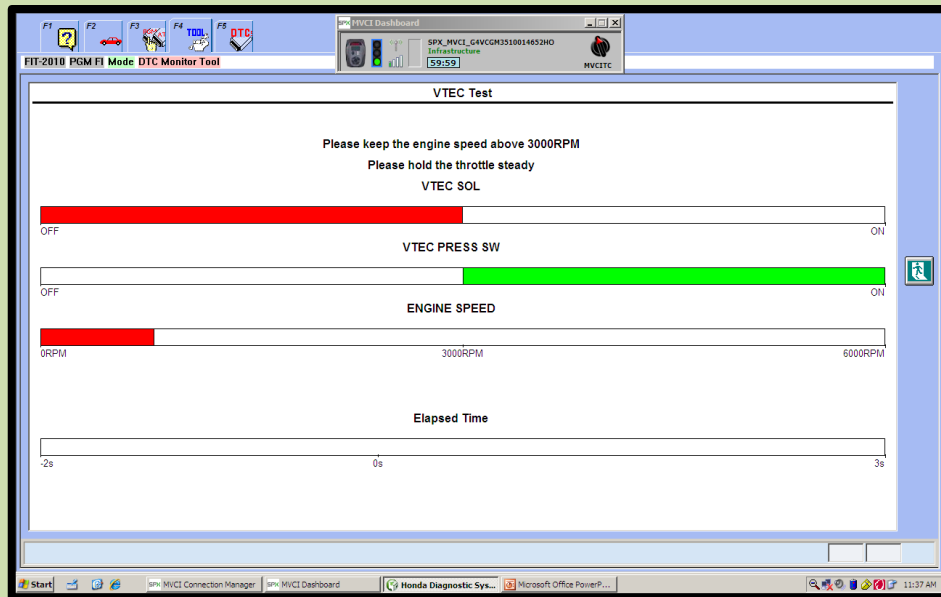
Note: This Function does not support for 03MY to 07MY ACCORD MT (manual transmission).

Vehicles not equipped with the VTEC oil pressure switch:
Activates the VTEC solenoid valve.

The bottom of the window shows the Windows taskbar with the Start button, SPX MVCI Connection Manager, SPX MVCI Dashboard, Honda Diagnostic Sys..., and Microsoft Office PowerP... open. The system clock shows 11:32 AM.

Opposite states: Pressure switch vs. VTEC solenoid

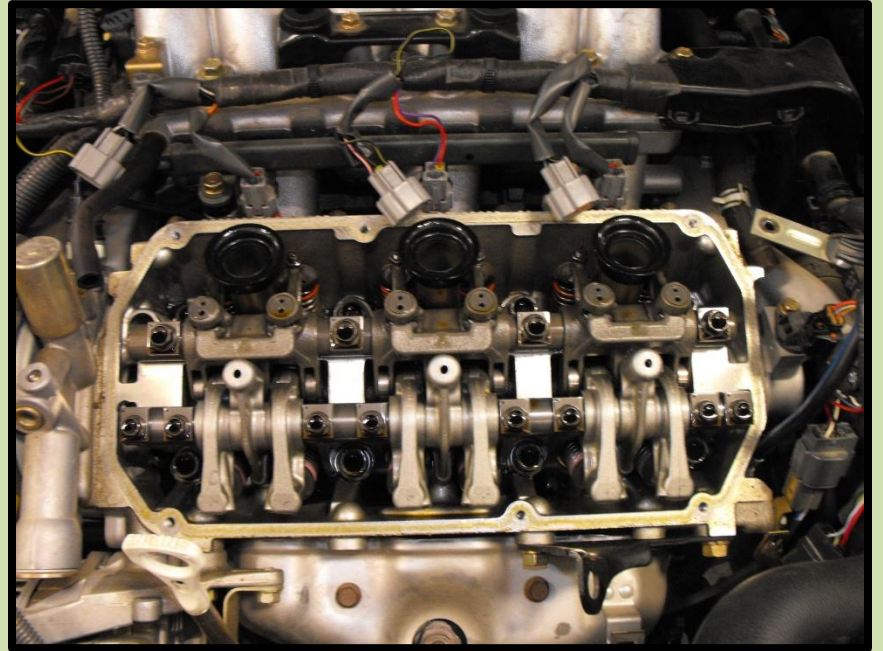
Lobe Switching Style



Scan tool VTEC test

Lobe Switching style

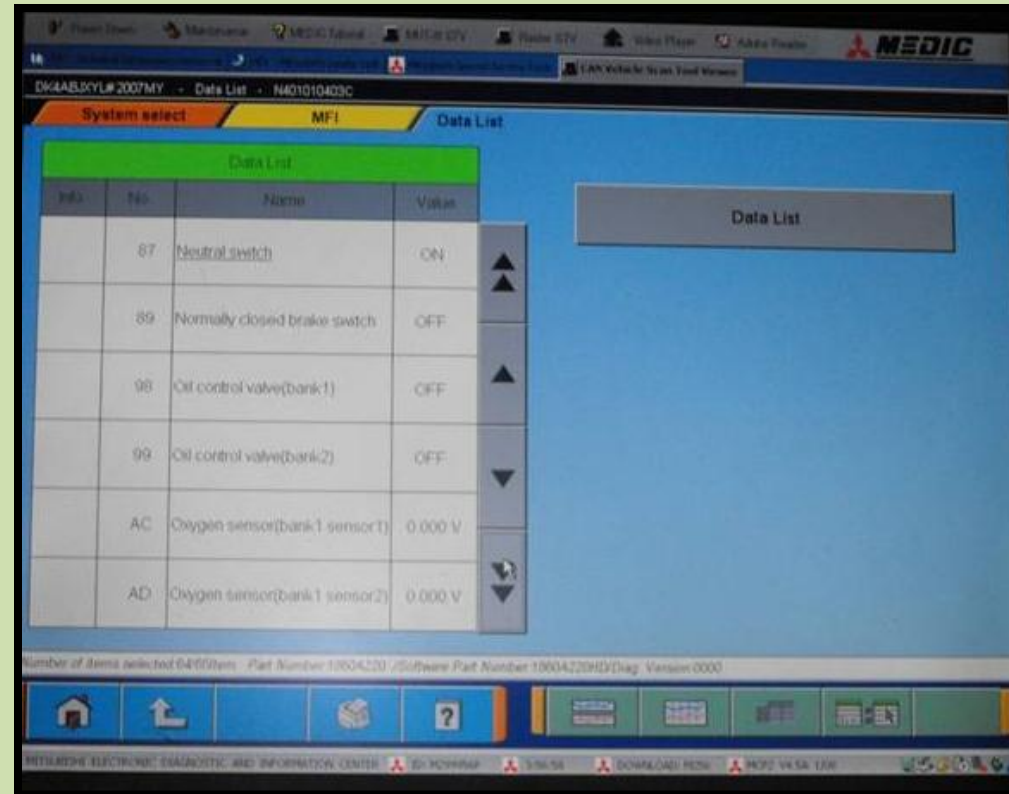
- Mitsubishi MIVEC uses similar rocker arm connections to switch between camshaft lobes



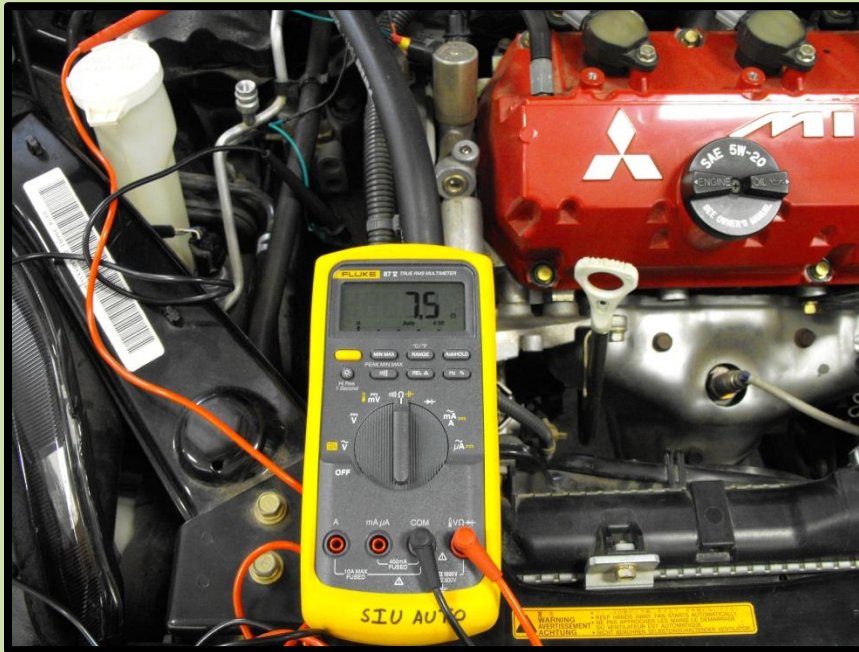
3.8 V-6 bank 2, intake towards top

Lobe Switching style

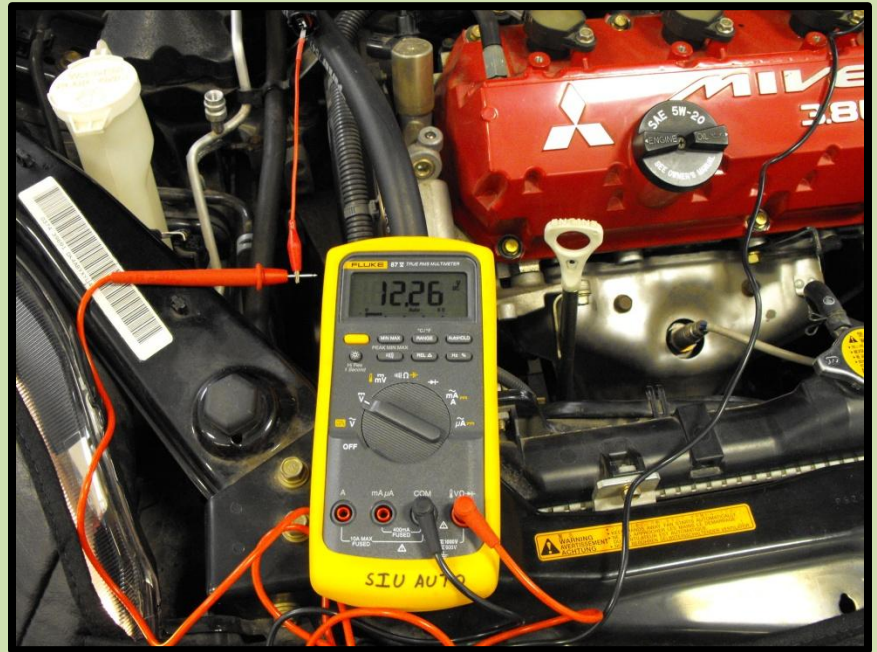
- MUT 3 scan tool
Datastream shows
OCV states and
provides actuator test



Lobe Switching style



OCV solenoid @ 7.5Ω



Solenoid fed 12v from MFI relay,
PCM grounds solenoid

Lobe Switching style



MIVEC video clip

Lobe Switching style



Active test: vacuum drops when high lift activated

Conclusion

This presentation will be posted in PDF form on <http://opensiuc.lib.siu.edu/>

Google: “open SIU”

Questions/comments: dixonm@siu.edu

618-453-9134, thank you for attending