Fall 2012

Variable Camshaft Timing/ Variable Valve Timing

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Presented at the Fall 2012 ICAIA Conference, Joliet Junior College, Joliet, IL.

Variable Camshaft/Valve Timing

Presented by Matt Dixon,
SIUC Automotive Technology

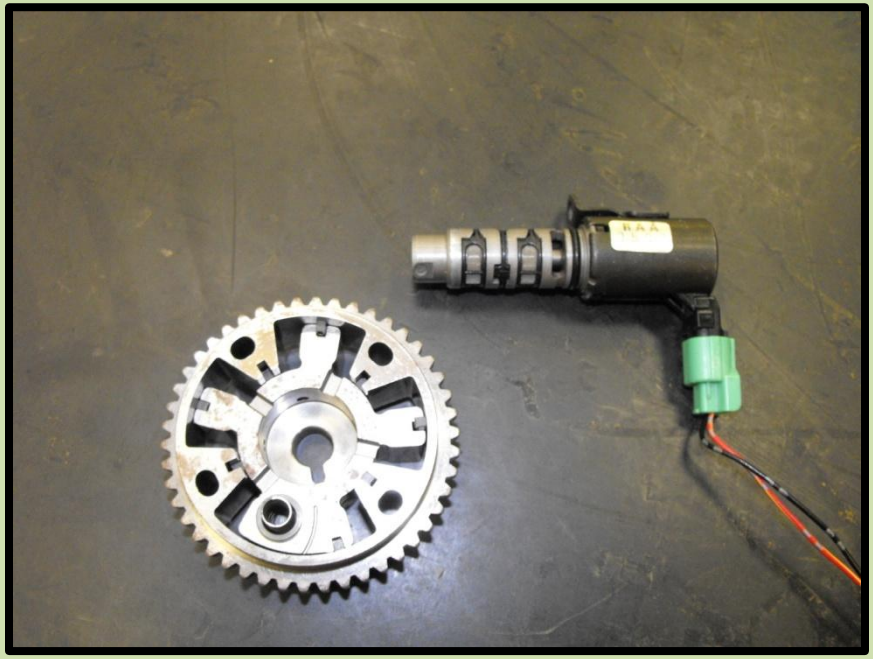
ICAIA Conference fall 2012 at
Joliet Junior College

Phaser & Lobe switching styles

Phaser Variable Timing

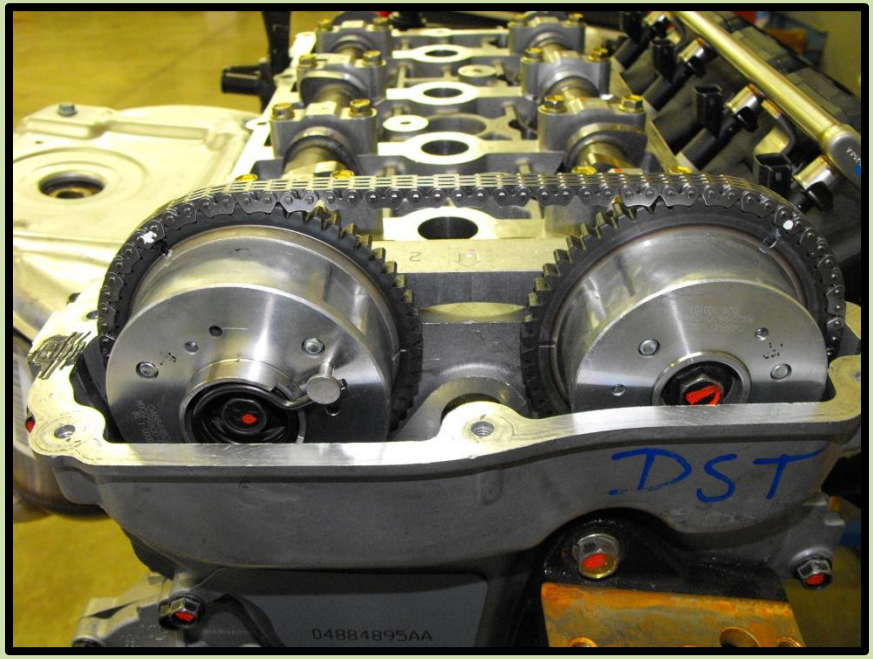
Changes in cam timing alter lobe centerlines & lobe separation angles to:

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



Phaser Style: topics

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

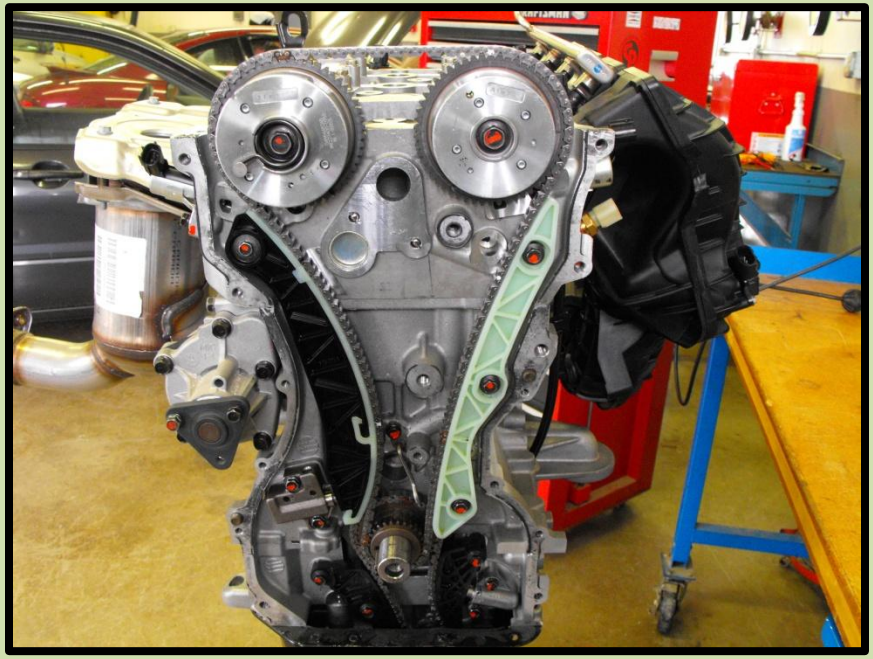


Phaser Style: Mechanical

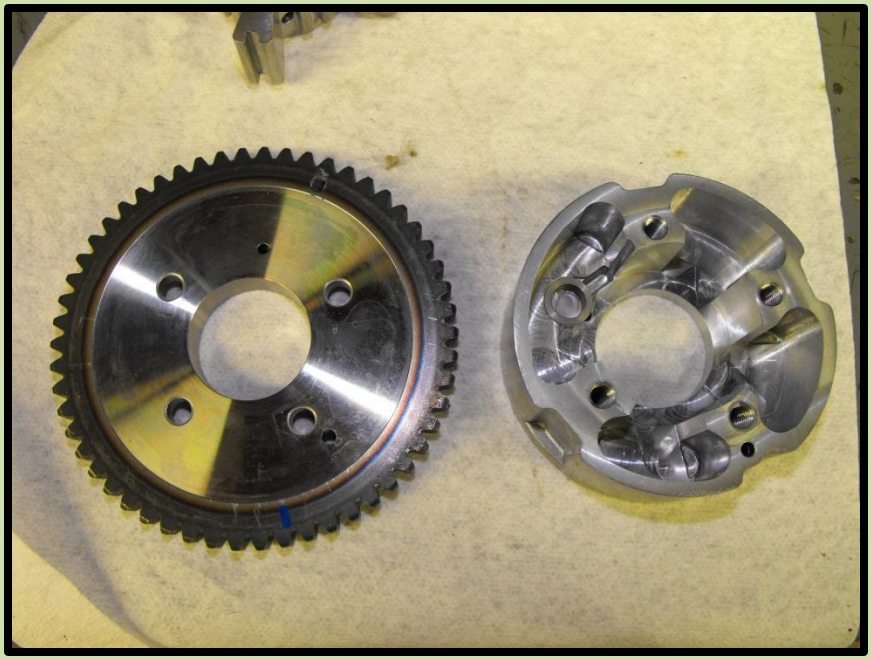
- Most manufacturers use a **phaser** on the front of the camshaft(s).
- Vaned rotor connects to cam, outer body connects to chain driven sprocket
- Typical default: **Exhaust full advance**
  Intake full retard

Phaser Style: Mechanical

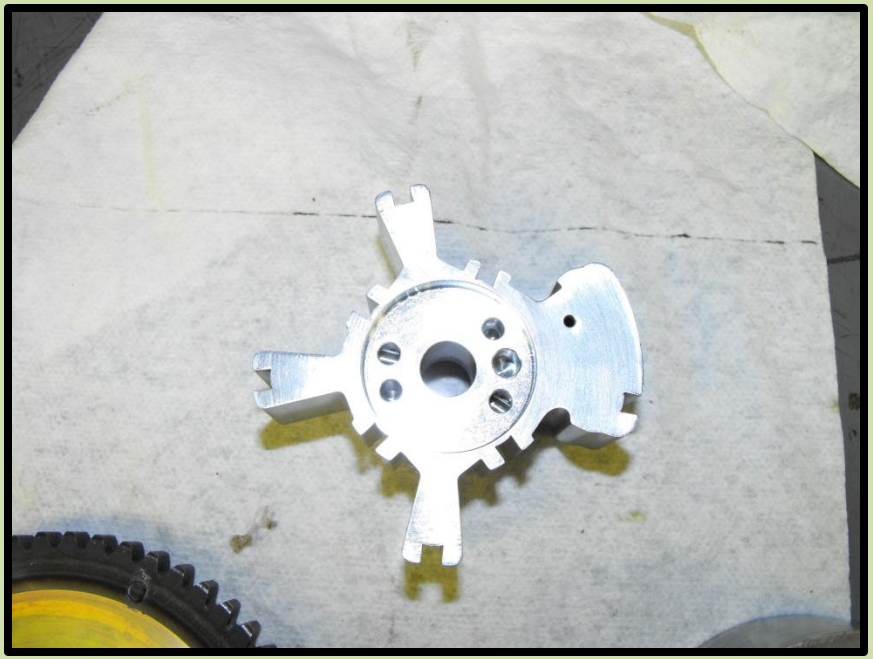
- Timing chain drives the camshaft sprockets
- The exhaust cam is on the left, intake cam on the right
- Clockwise rotation from the front view



Phaser Style: Mechanical



Sprocket and
Phaser body



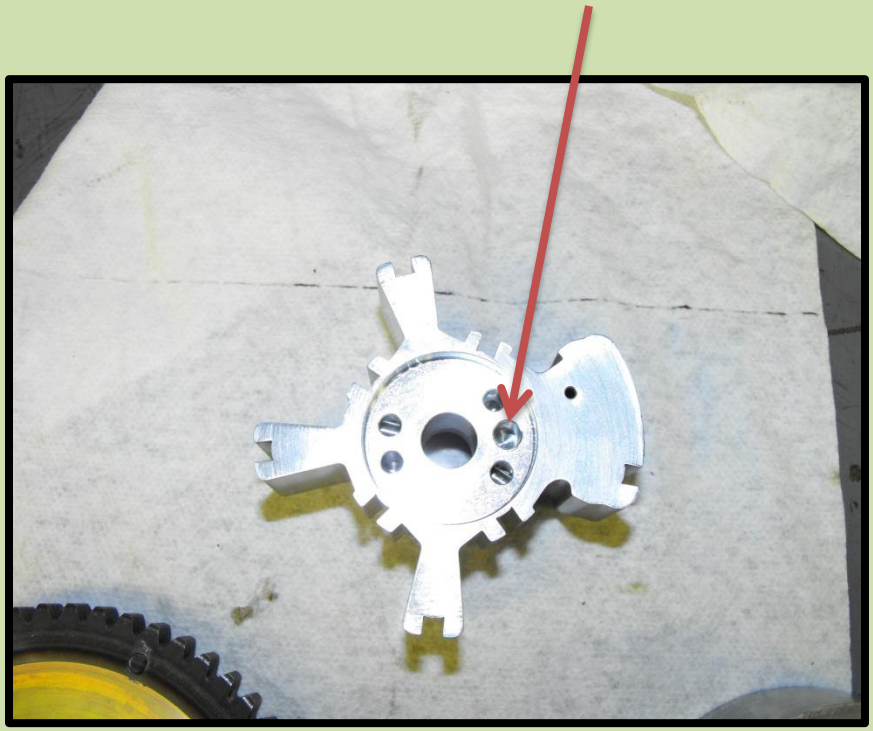
Rotor

Phaser Style: Mechanical

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

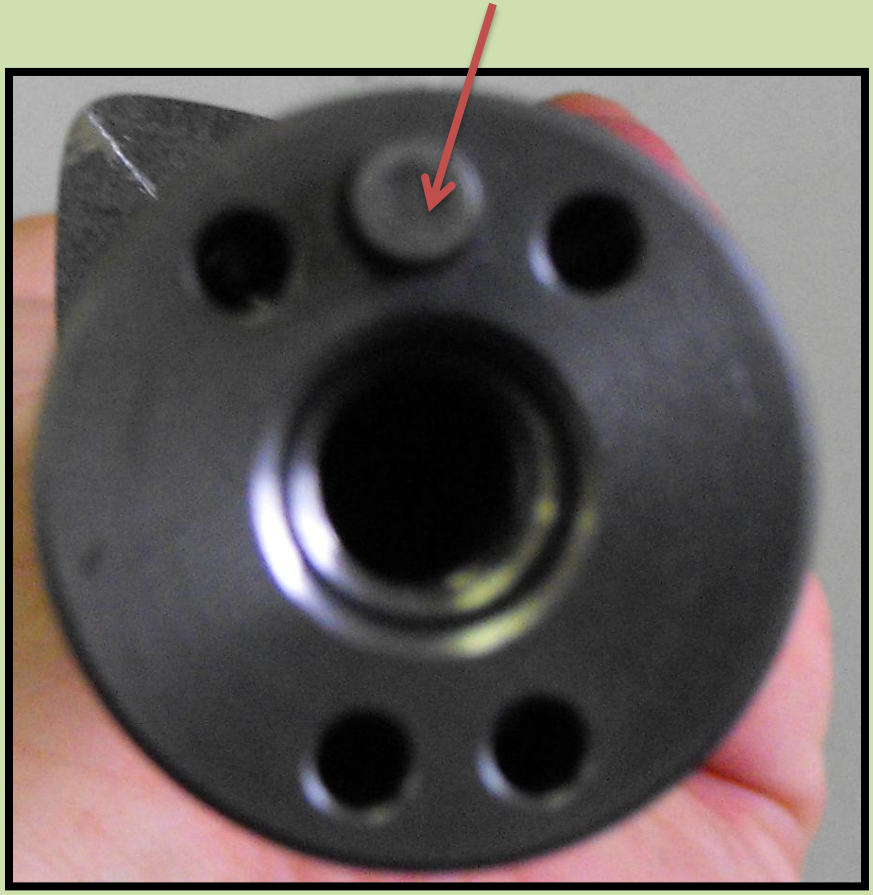
Phaser Style: Mechanical

- 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



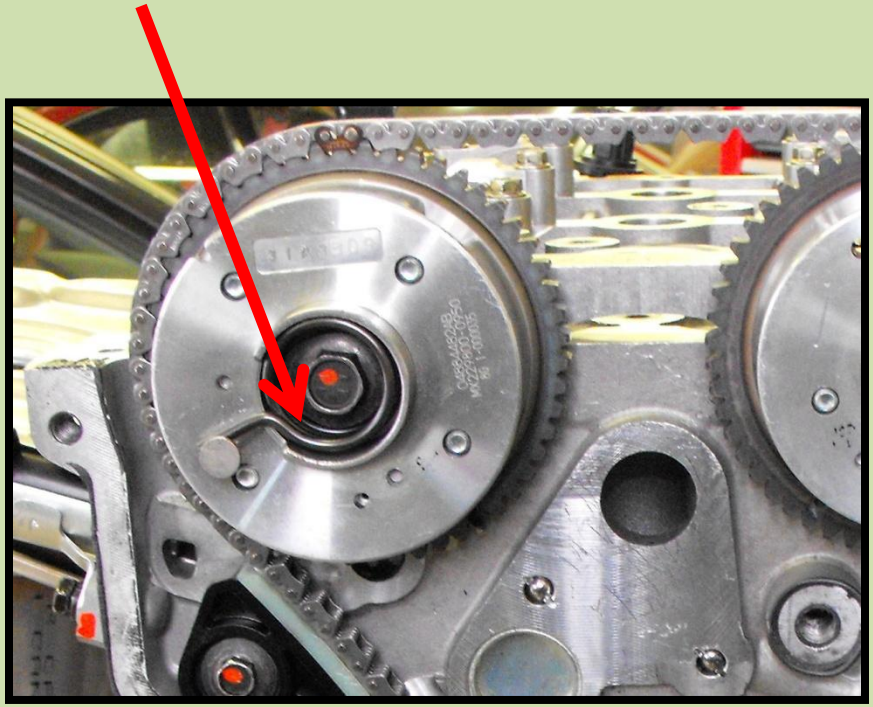
Phaser Style: Mechanical

- 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

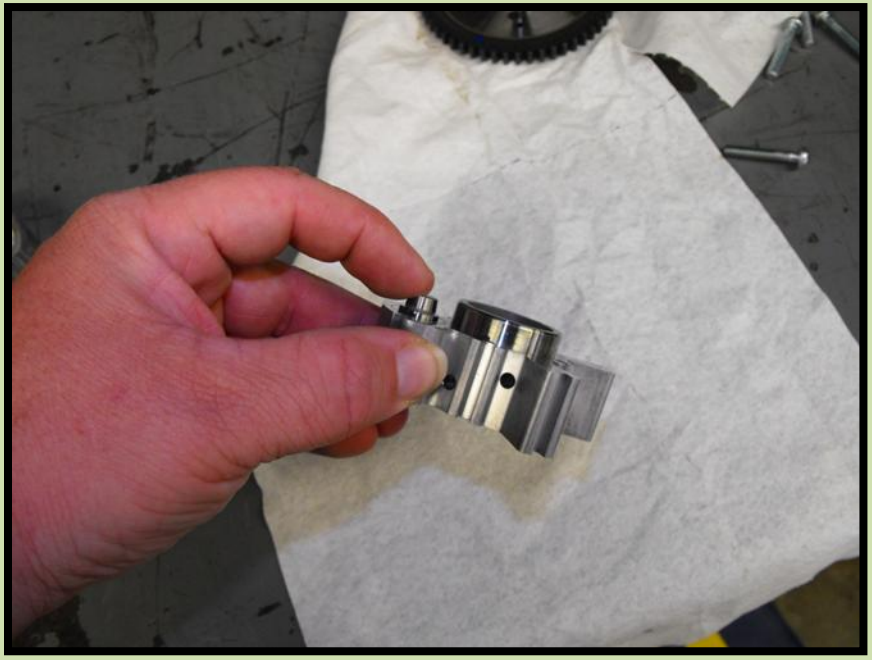
- Because the exhaust cam rests and lock in the fully advanced position, the rotor works against engine rotation

- The spring helps get the rotor to where the lock pin can engage

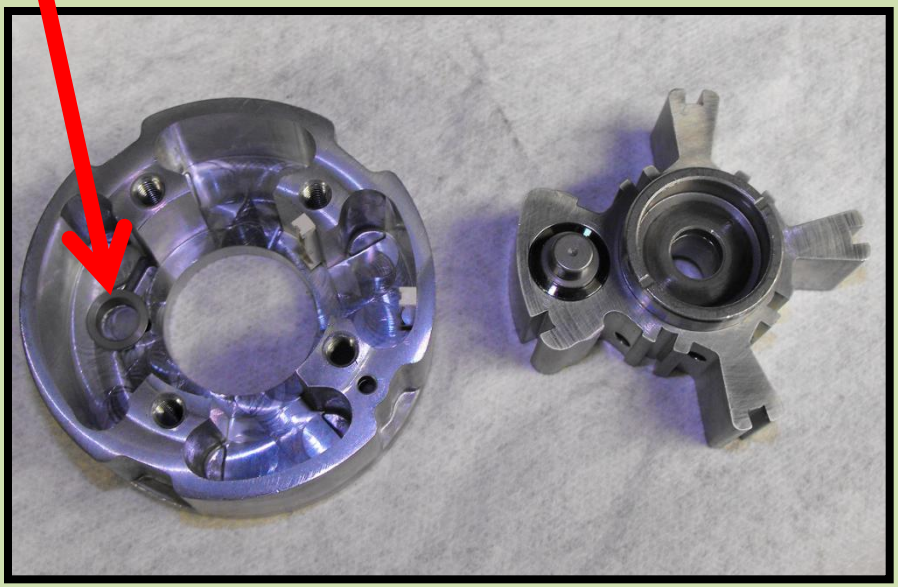


Phaser Style: Mechanical

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

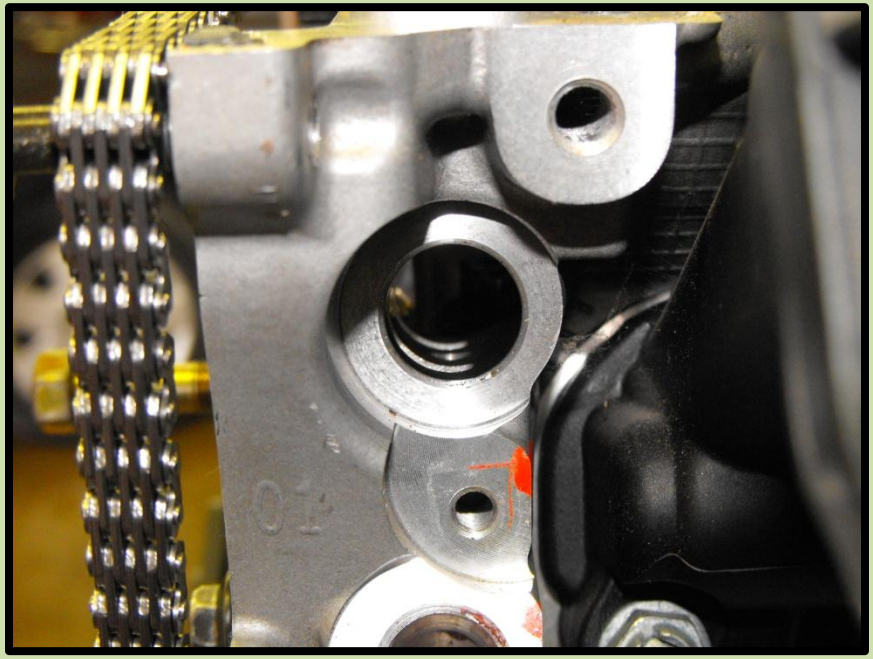
Phaser Style: Mechanical

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

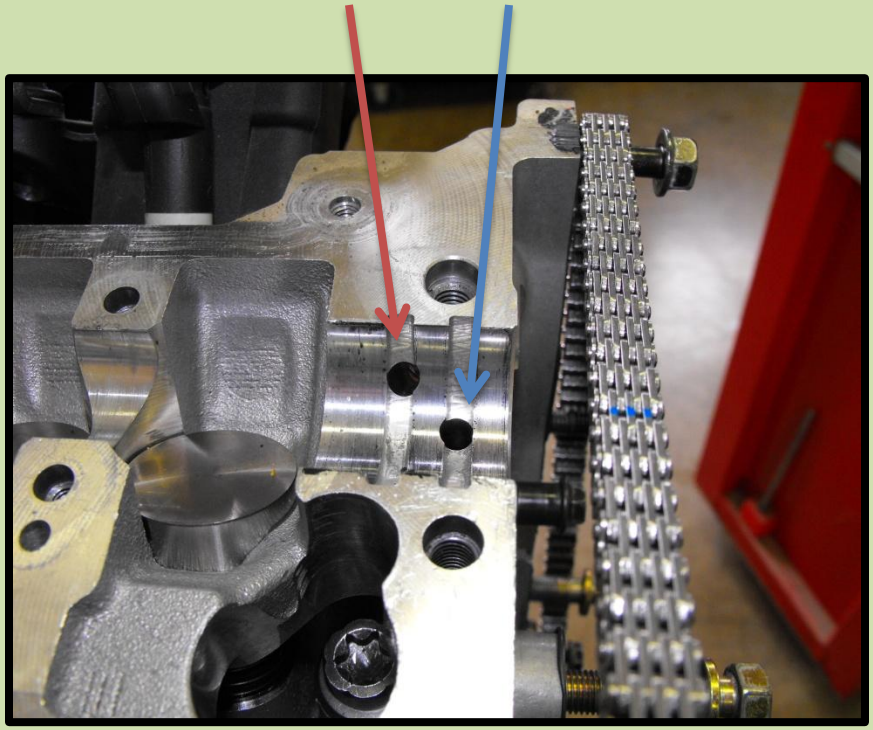
The pressure is directed by the oil control valve



O.C.V. port

Phaser Style: Hydraulic

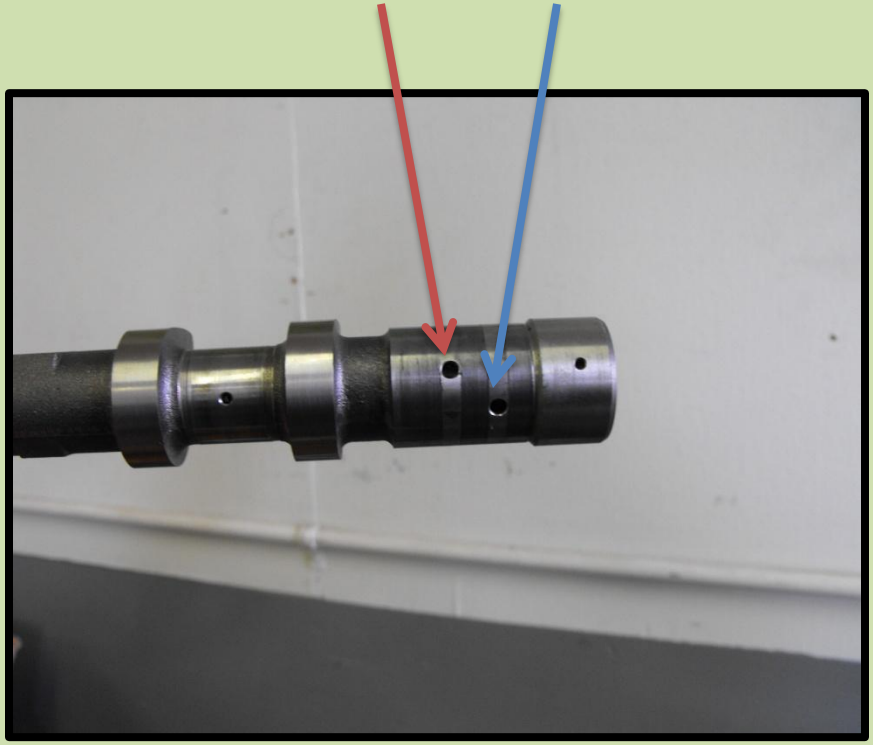
- OCV directs pressure to/from these ports in the first camshaft bearing



1st cam journal “A” and “B” ports

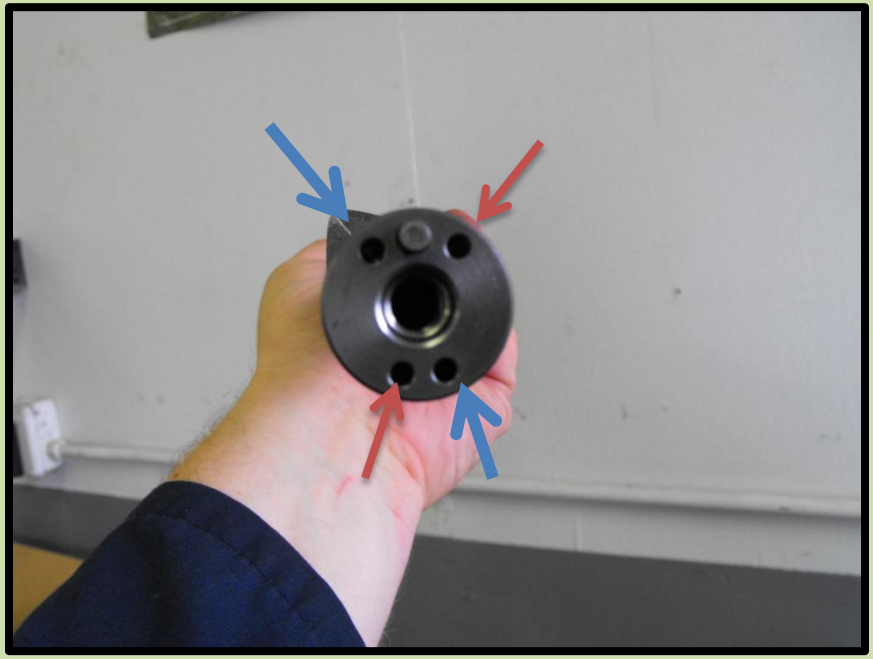
Phaser Style: Hydraulic

- 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

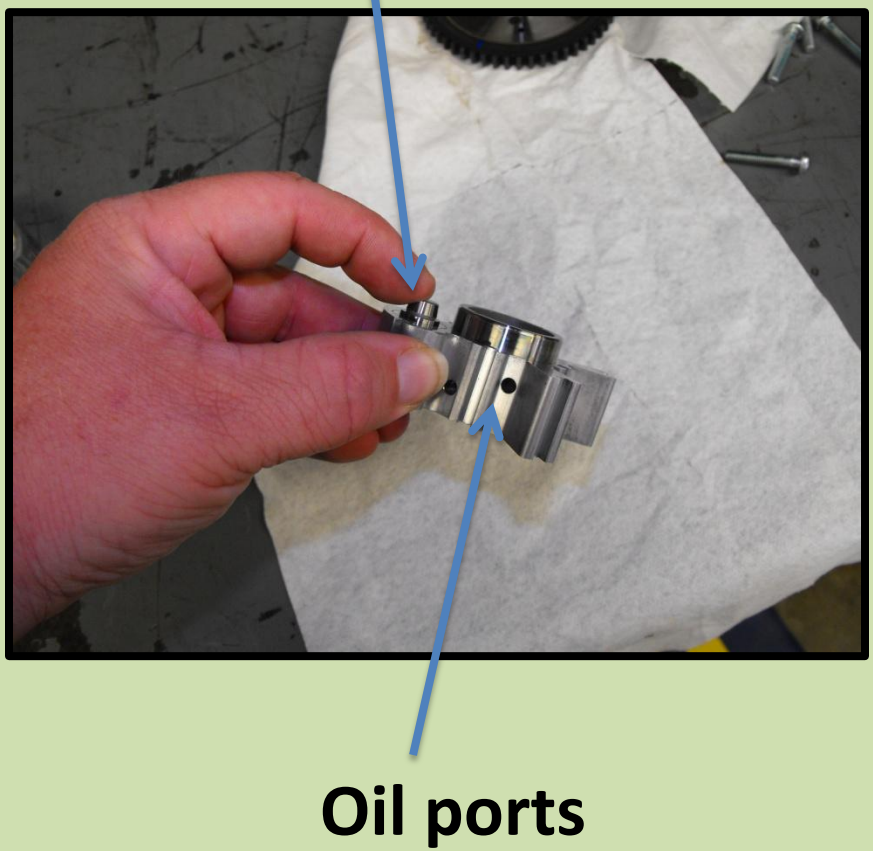


Phaser Style: Hydraulic

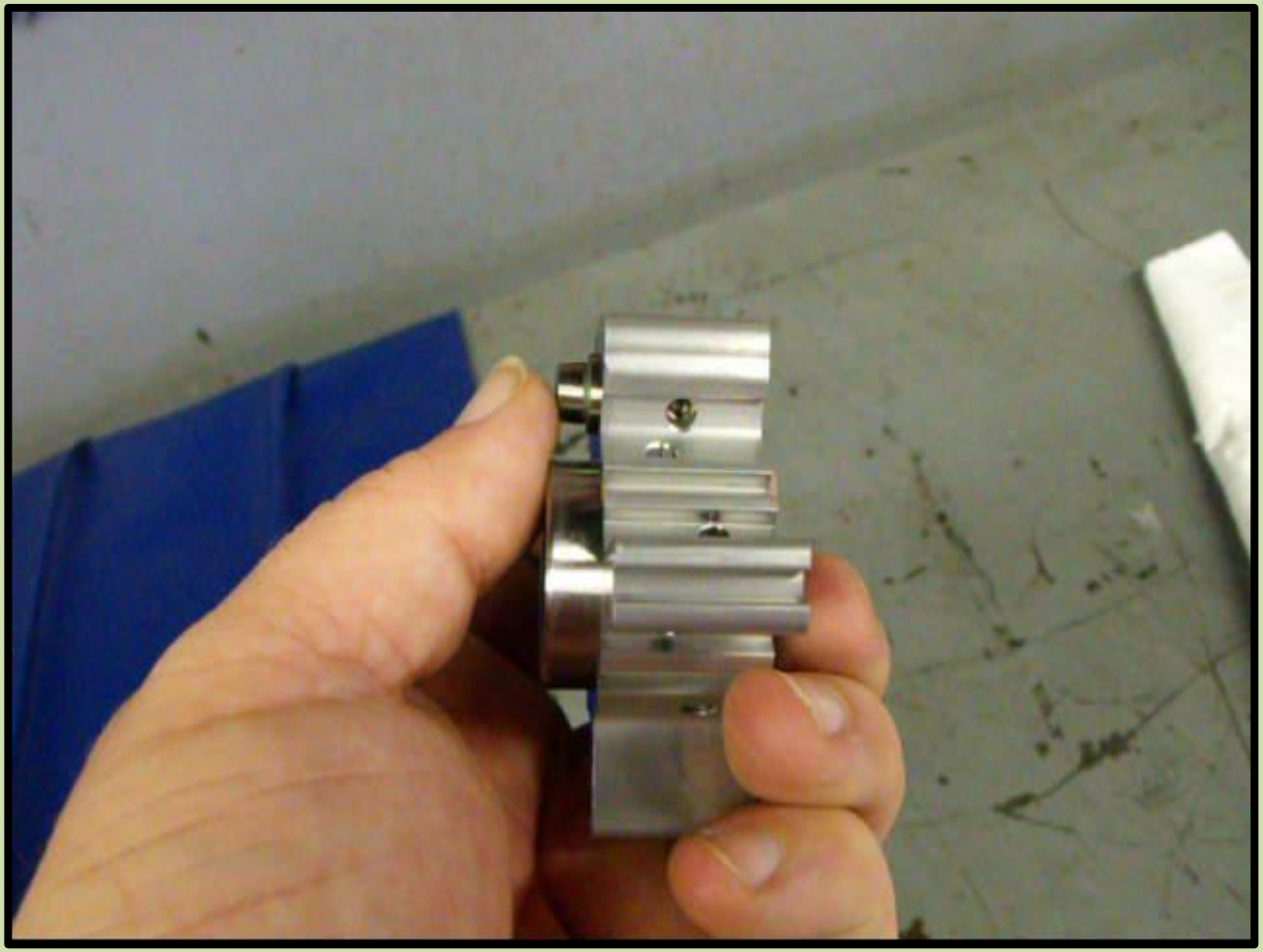
- The 4 camshaft ports connect to 4 ports (2 groups of 2 ports) on the phaser assembly

Phaser Style: Hydraulic

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

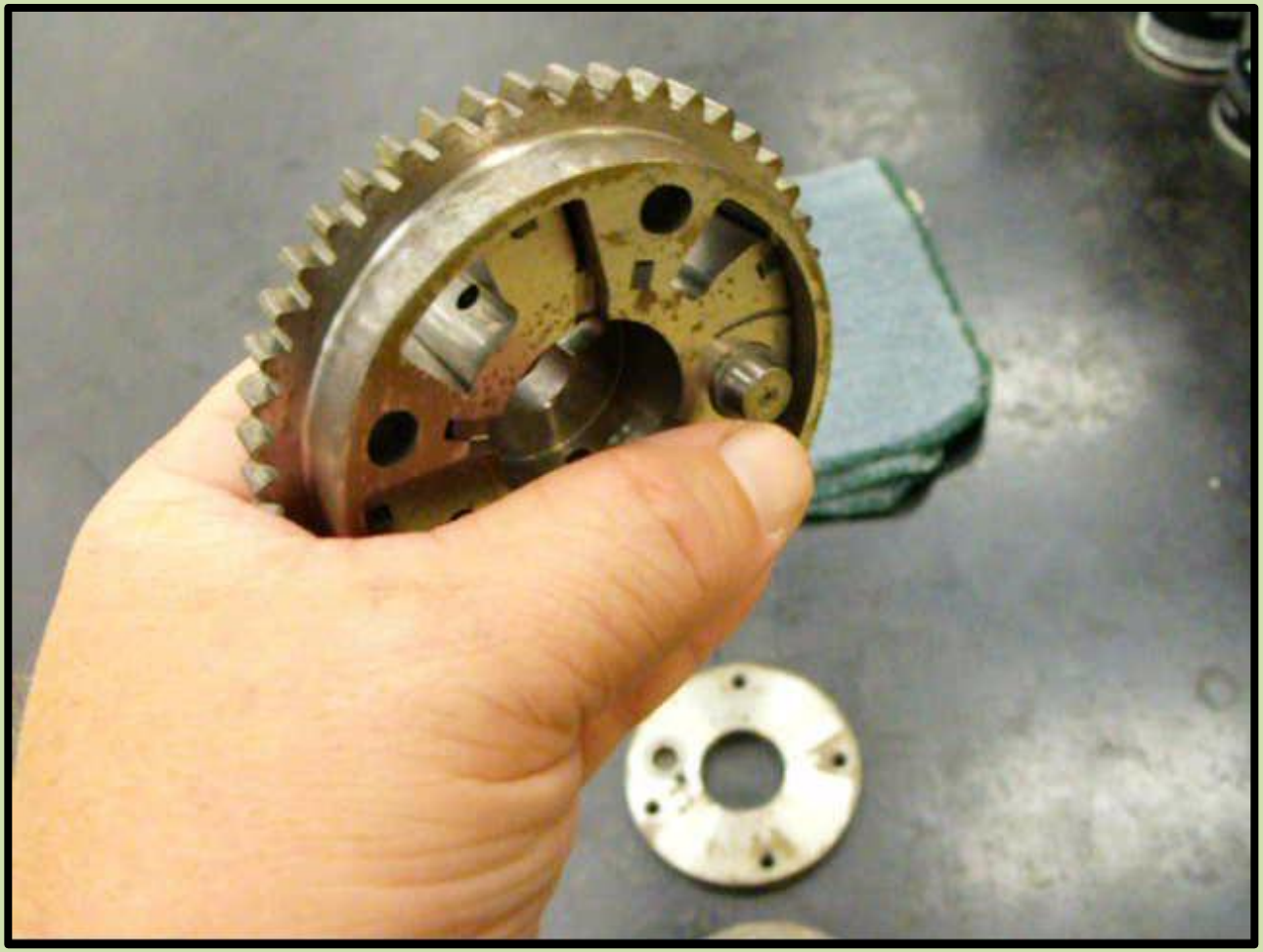


Phaser Style: Hydraulic



Lock pin video clip #1

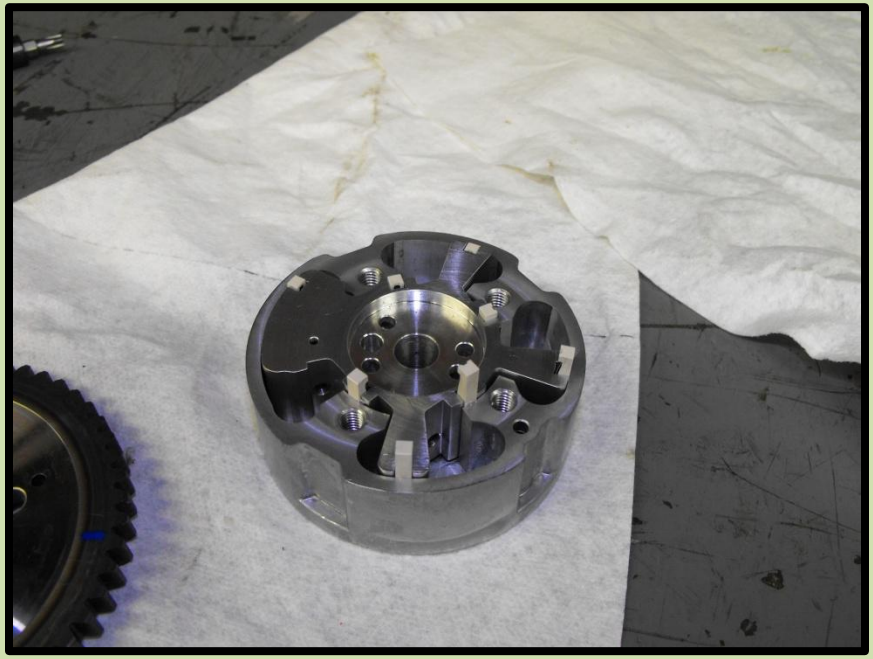
Phaser Style: Hydraulic



Lock pin video clip #2

Phaser Style: Hydraulic

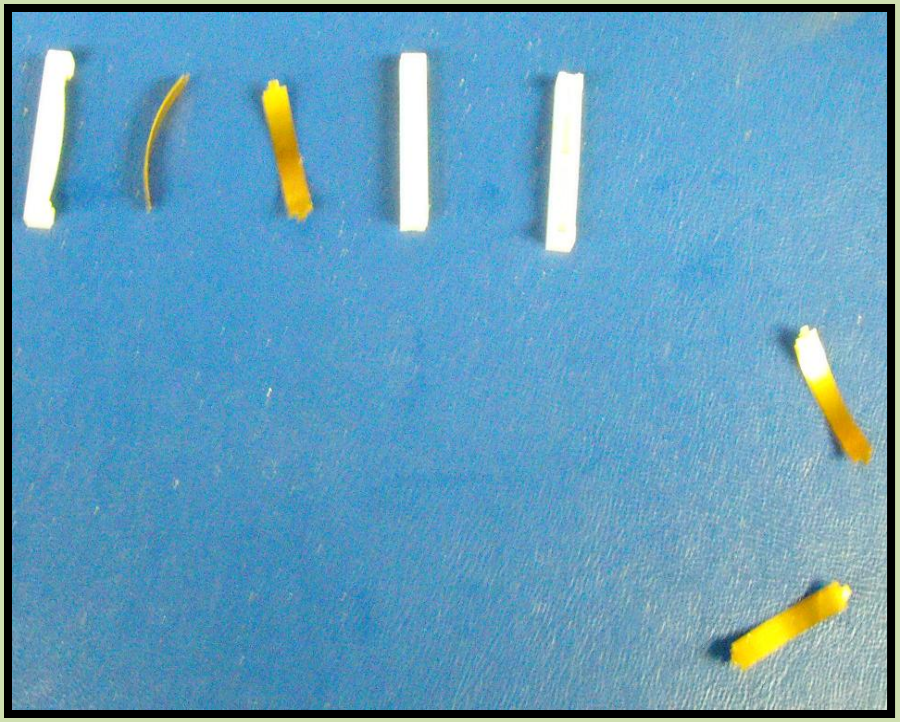
- There are 8 oil seals between the rotor and the housing
- These seals are spring loaded with a small strut spring



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

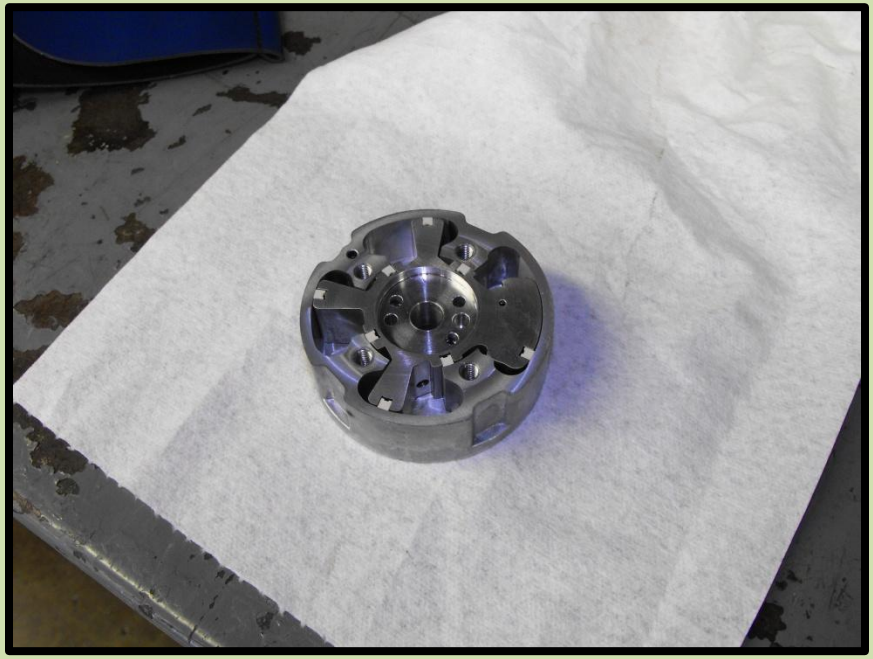
Phaser Style: Hydraulic

- 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



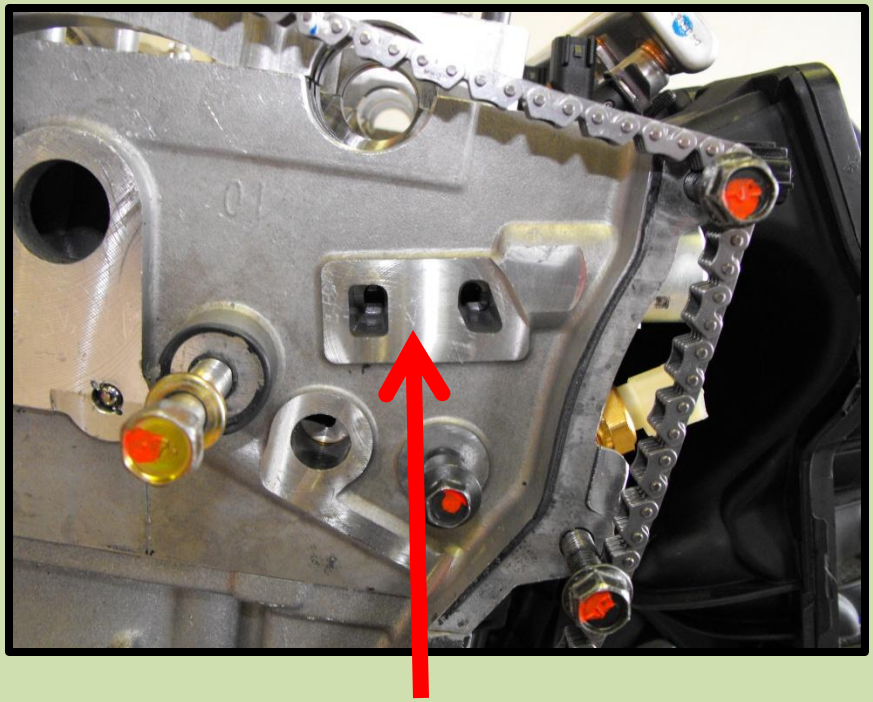
Phaser Style: Hydraulic

Movement video clip

Phaser Style: Hydraulic

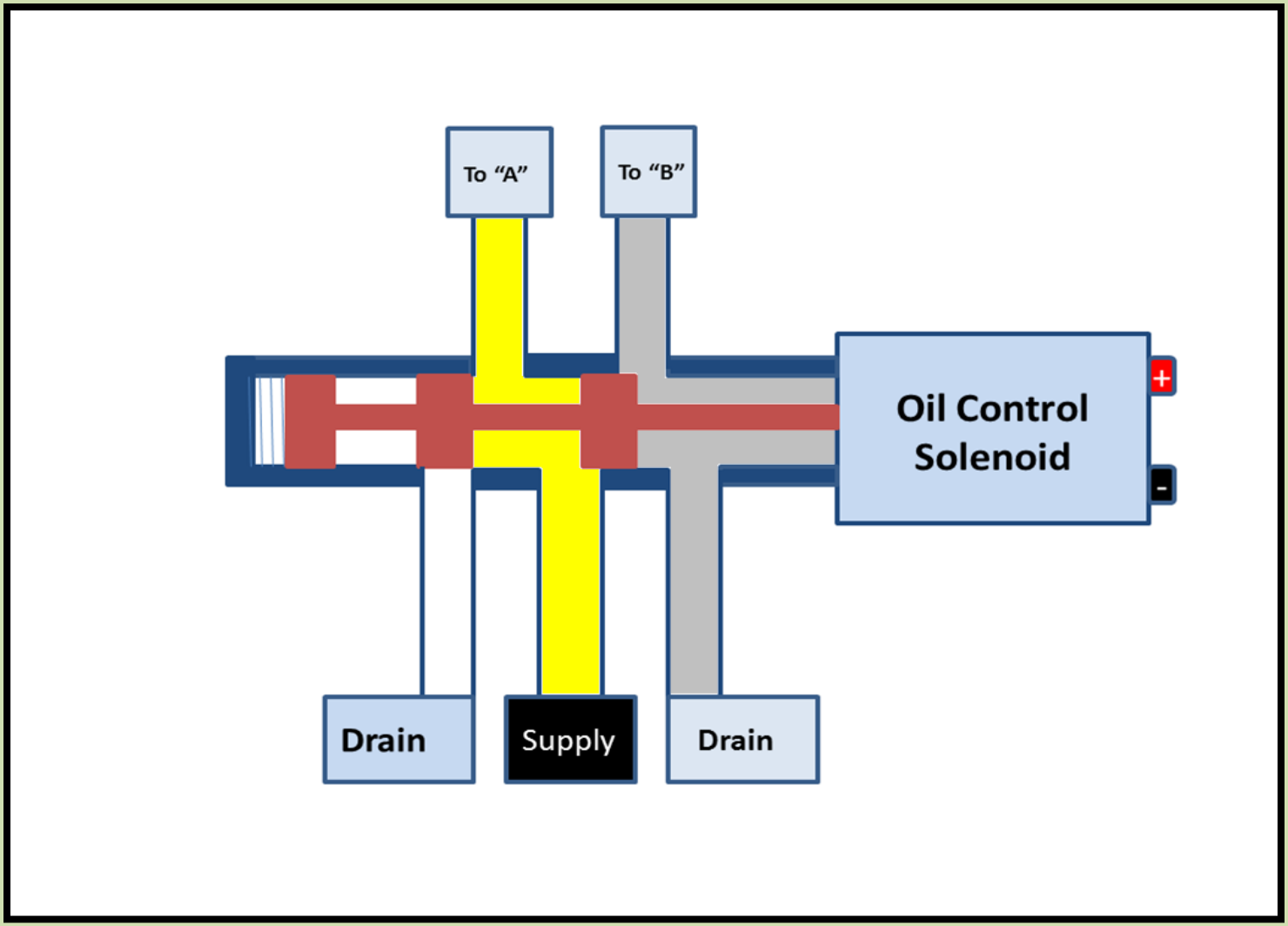
Path of oil vented ***from*** phaser:

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

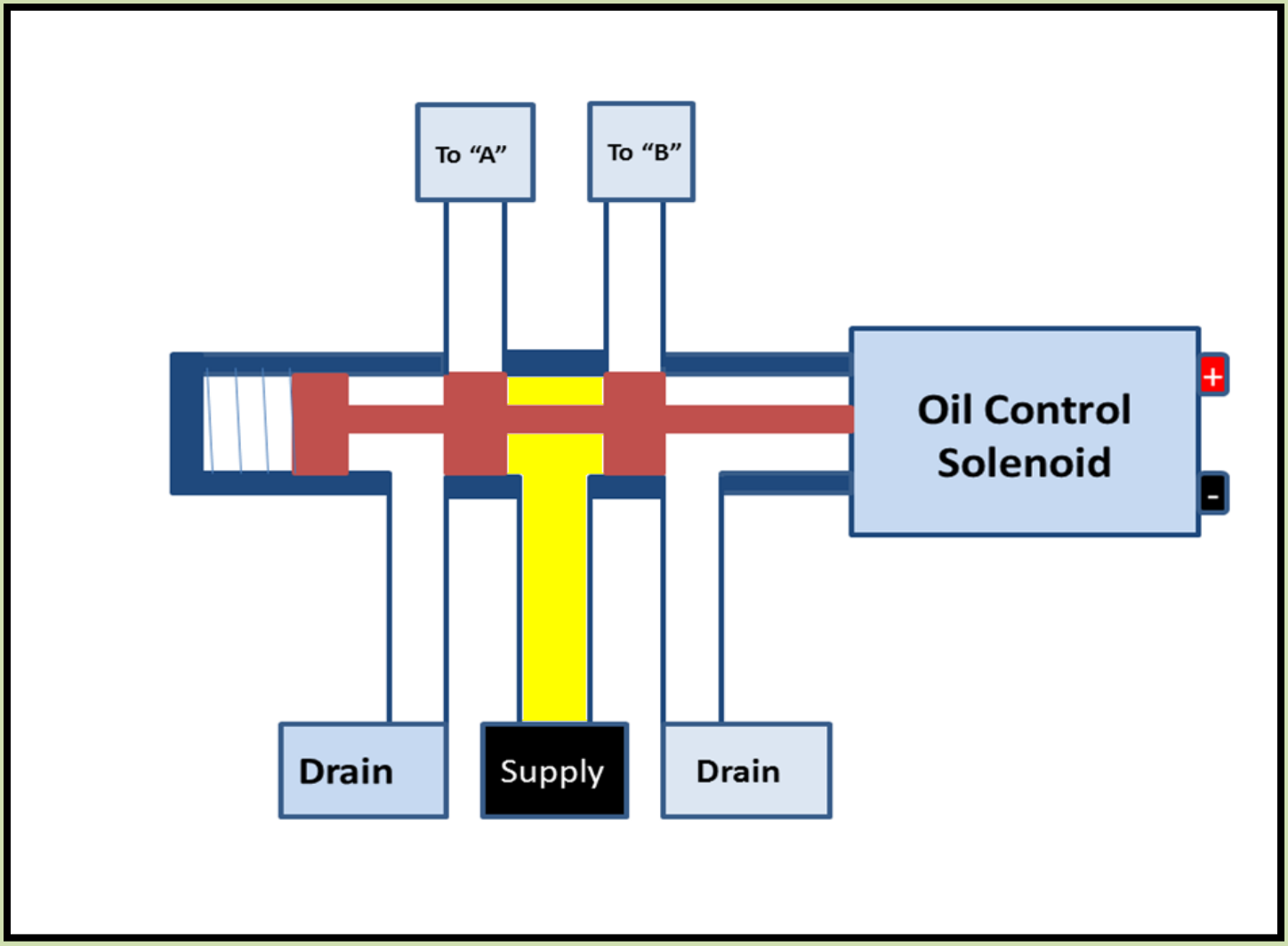


Oil Return Ports

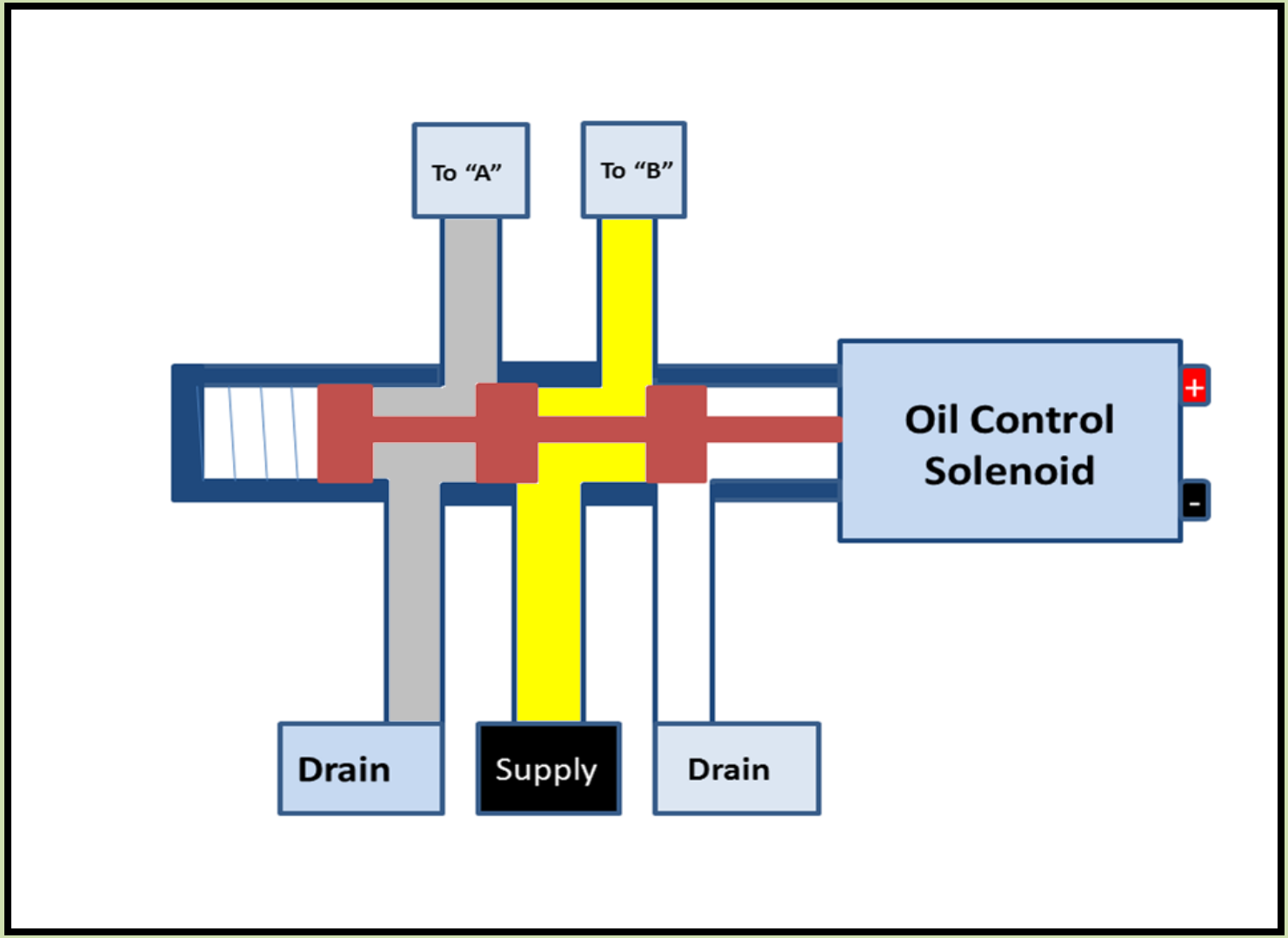
Phaser Style: Hydraulic



Phaser Style: Hydraulic

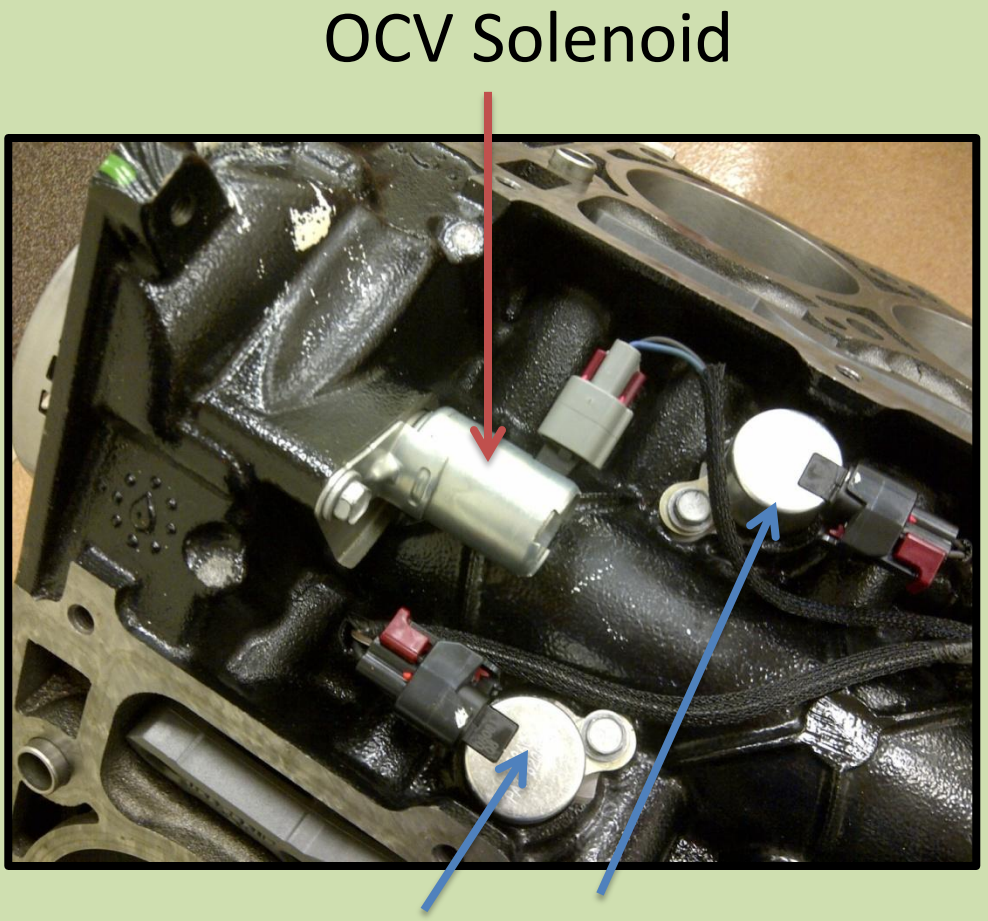


Phaser Style: Hydraulic



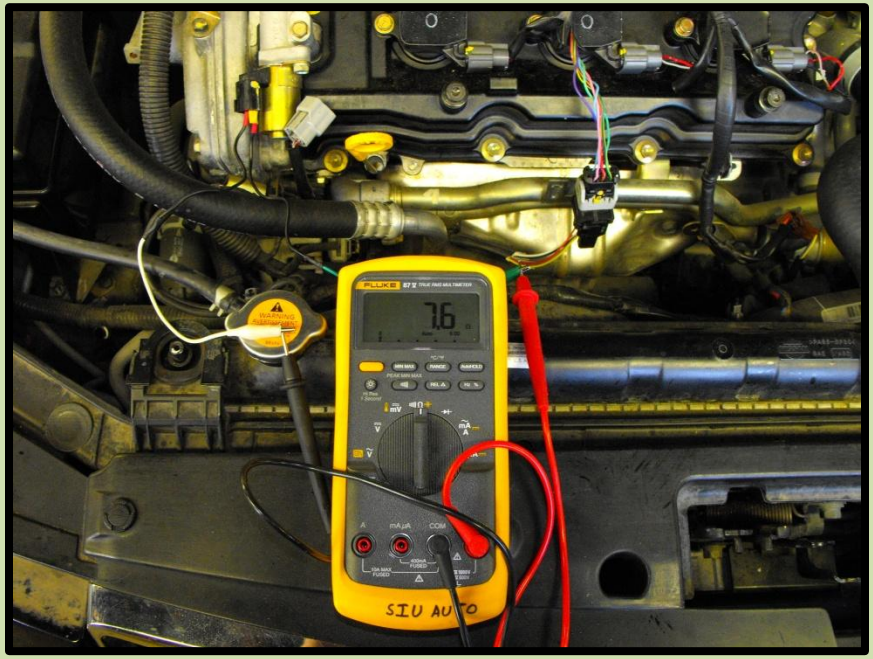
Phaser Style: Electrical

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



Phaser Style: Electrical

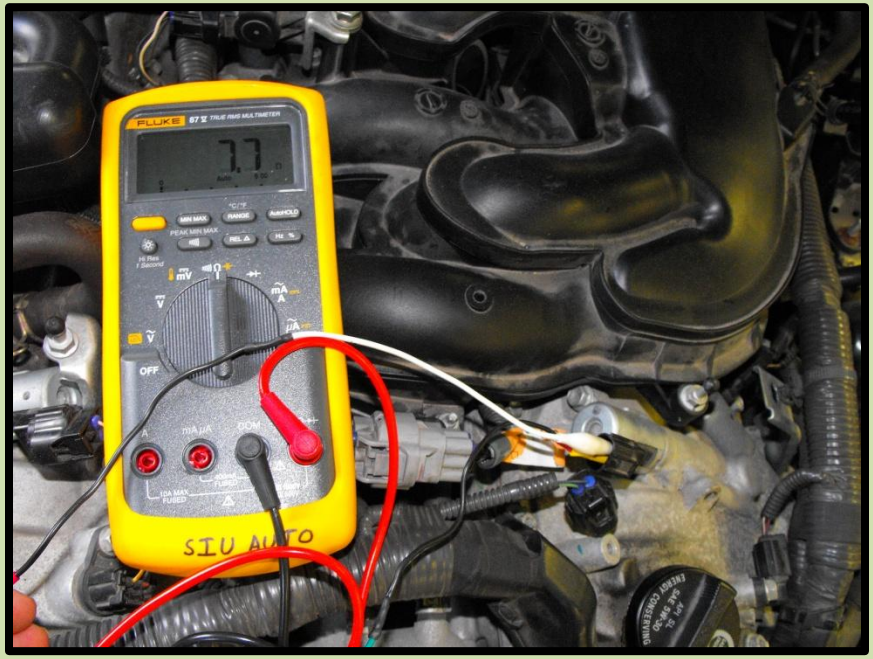
- Most oil control solenoids are 7-12 ohms @ room temperature
- They can vary with engine temperature



2007 Nissan Maxima 3.5

Phaser Style: Electrical

2005 Ford 5.4 Litre F-150



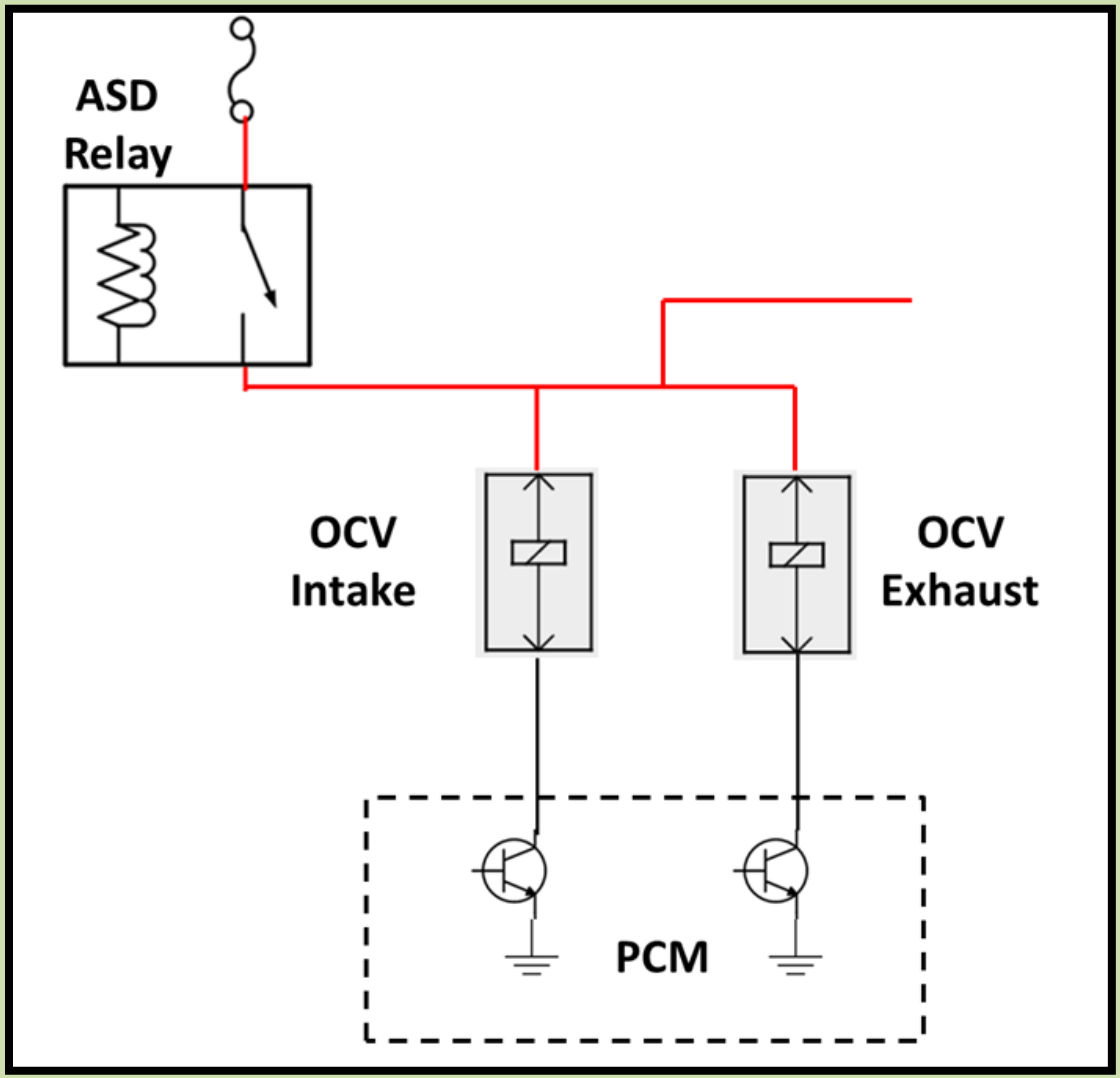
2006 Lexus IS 350

Phaser Style: Electrical

2012 Jeep Wrangler 3.6

2008 Dodge Caliber 2.4

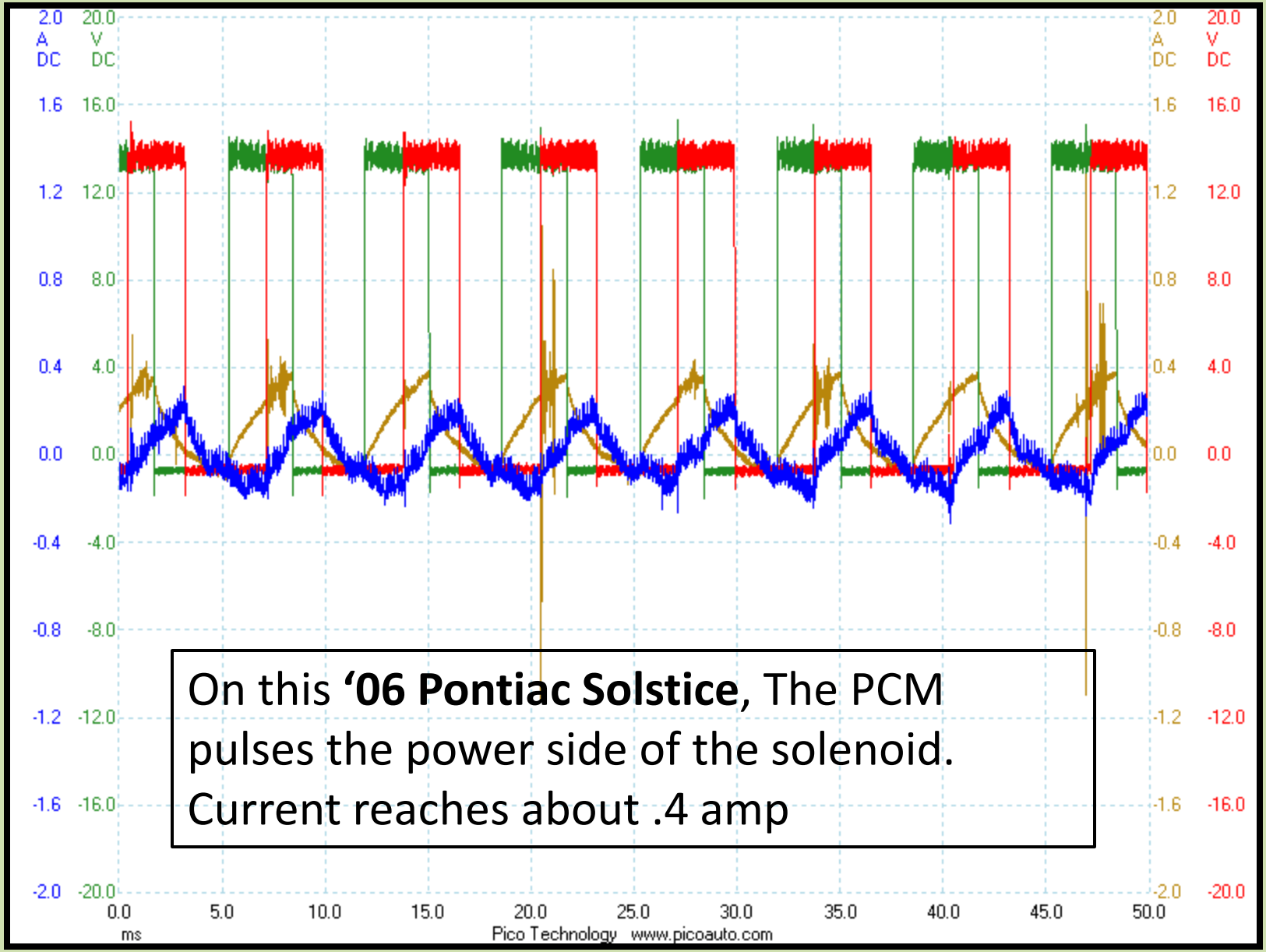
Phaser Style: Electrical



Basic
Schematic

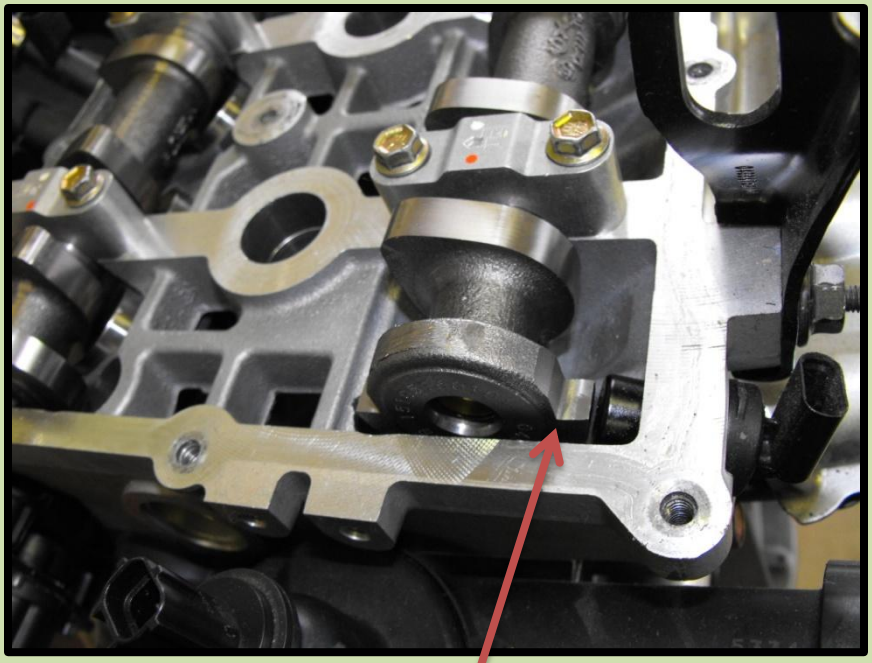
2012 Dodge
Caliber 2.4

PCM grounds
OCV solenoid


2.0 A DC
20.0 V DC
1.6 16.0
1.2 12.0
0.8 8.0
0.4 4.0
0.0 0.0
-0.4 -4.0
-0.8 -8.0
-1.2 -12.0
-1.6 -16.0
-2.0 -20.0
0.0 5.0 10.0 15.0 20.0 25.0 30.0 35.0 40.0 45.0 50.0
ms
Pico Technology www.picoauto.com
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

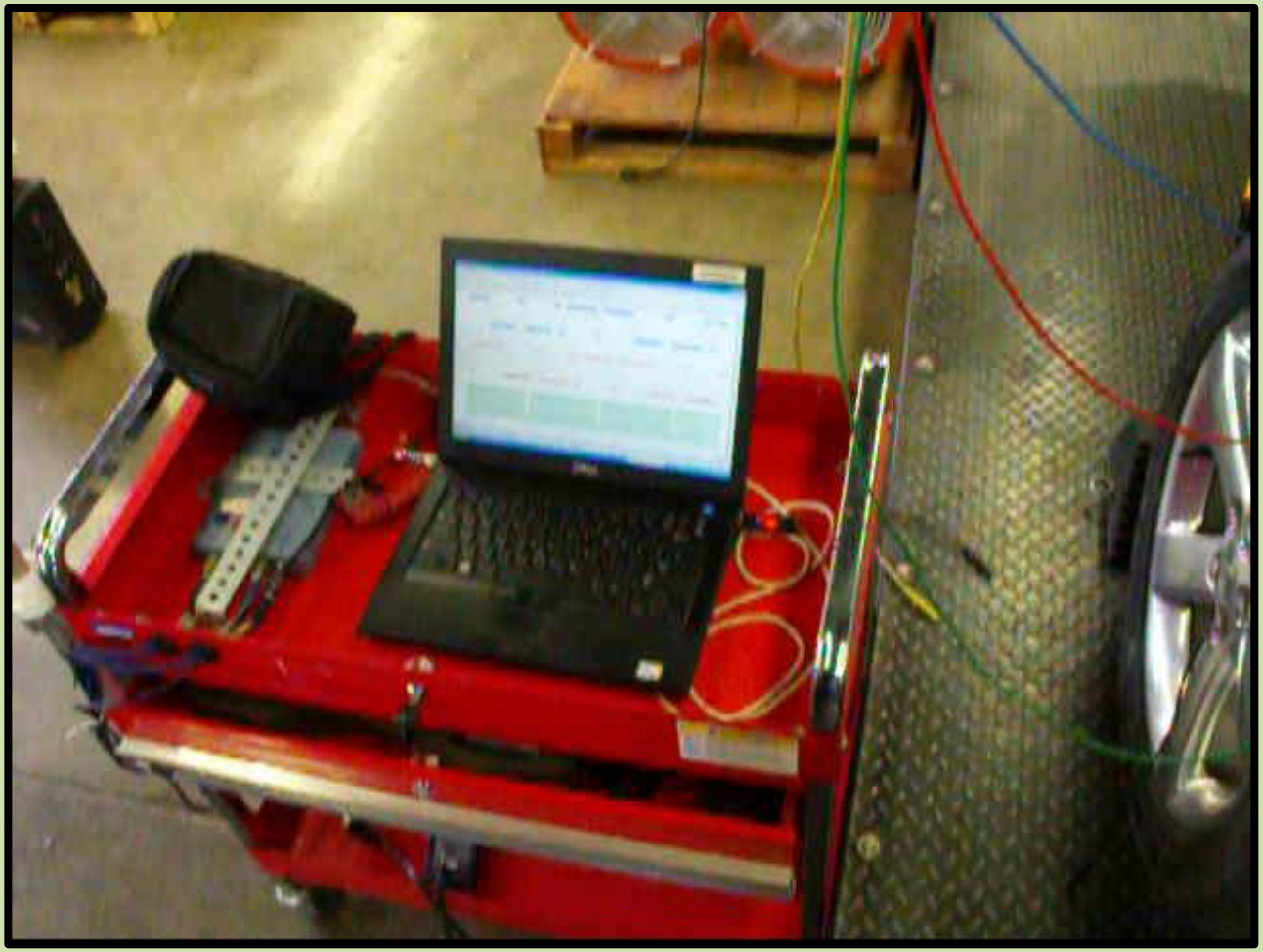


3 wire hall effect CMP sensor, “half moon” style tone ring

Phaser Style: Electrical

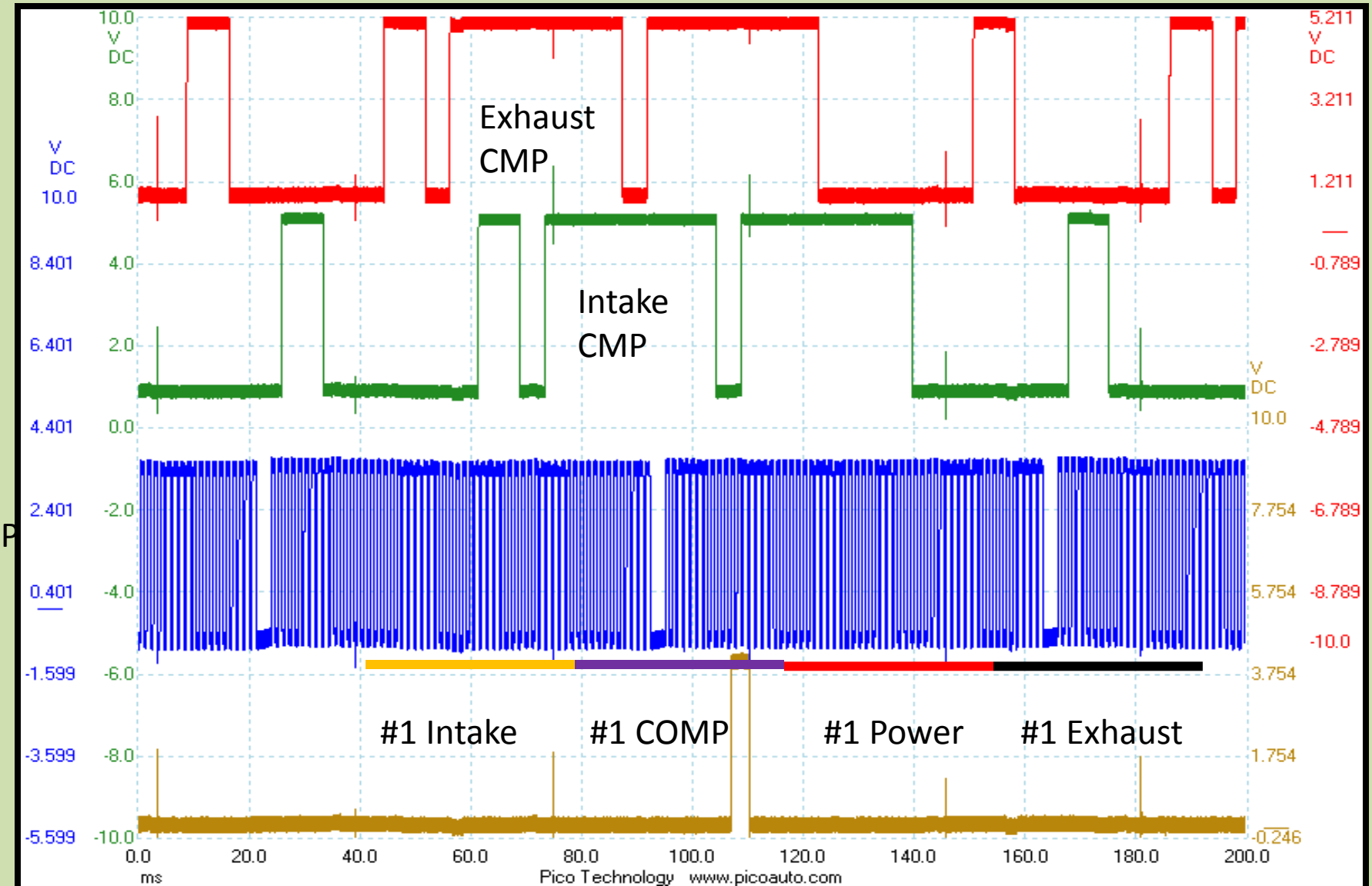
2303 manual activation video clip

Phaser Style: Electrical



2404 activate intake video clip

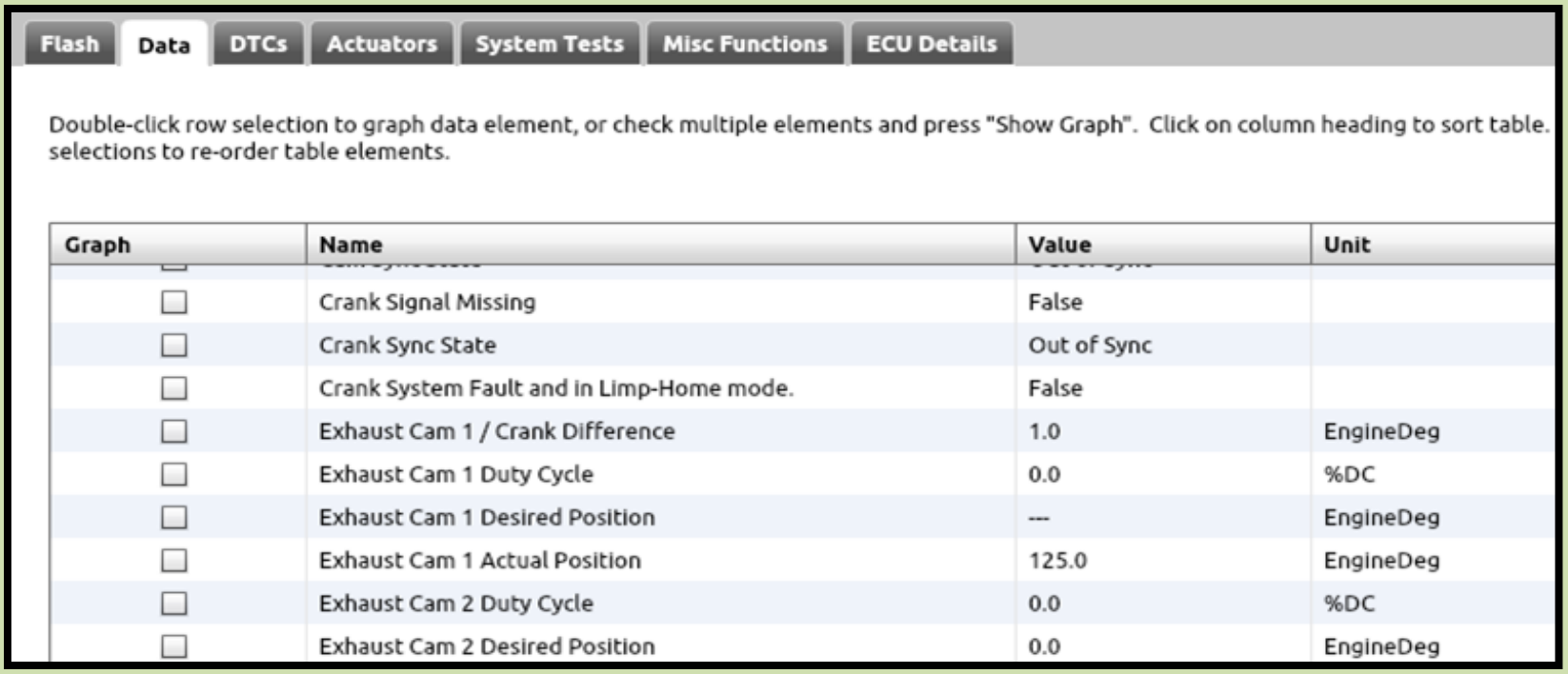
Phaser Style: Electrical



Phaser Style: Electrical

Data Stream from ‘06 Solstice

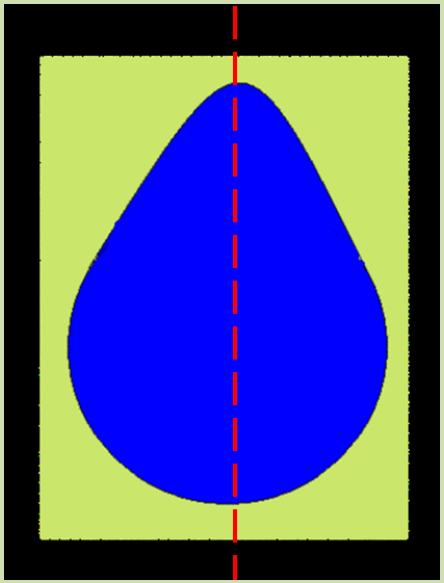
Phaser Style: Electrical

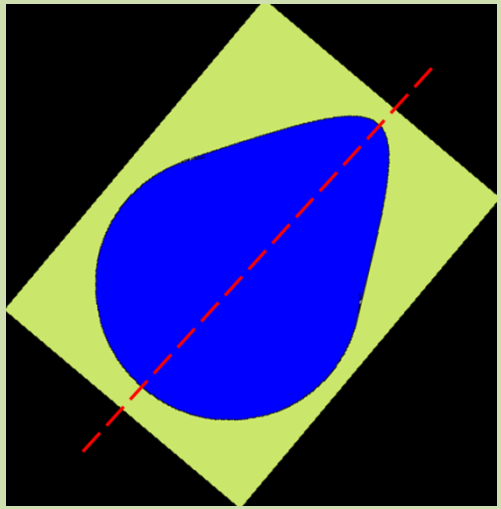


Data Stream from ‘12 Challenger

Phaser Style: Control Strategy

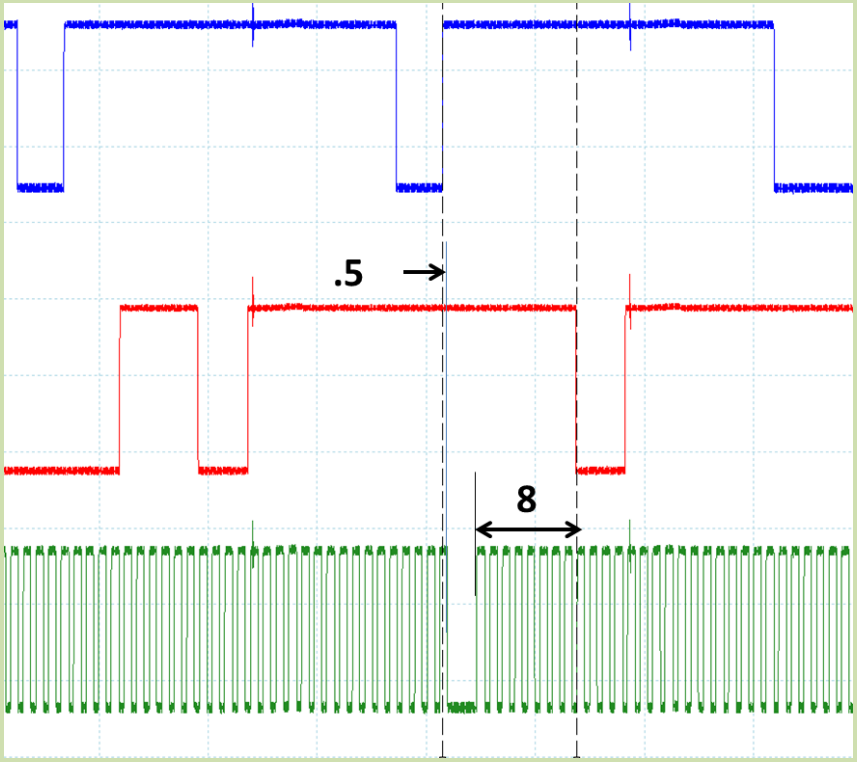
- PCM can alter cam position up to 40-45°
- Example ***Intake Cam*** SPEC: 260° Duration
- Default position (***Retard***) opens 2°ATDC closes 262° ATDC or 82° ABDC **Centerline= 132°**
- At 40°advance: opens 38° BTDC closes 42°ABDC **Centerline= 92°**



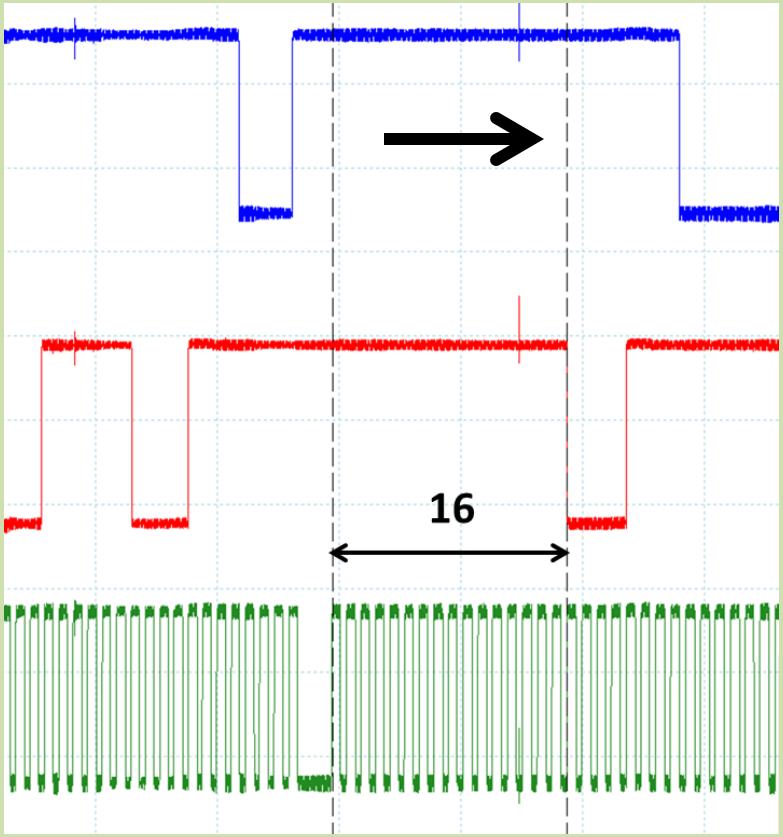


Phaser Style: Control Strategy

CKP vs. exhaust in Red @idle

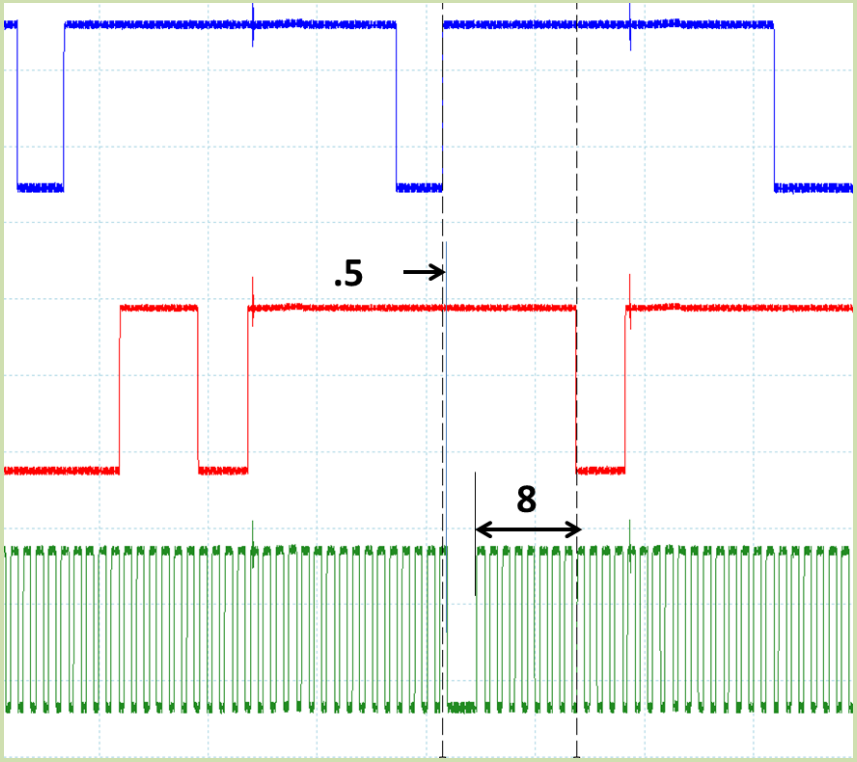


Exhaust @ full retard

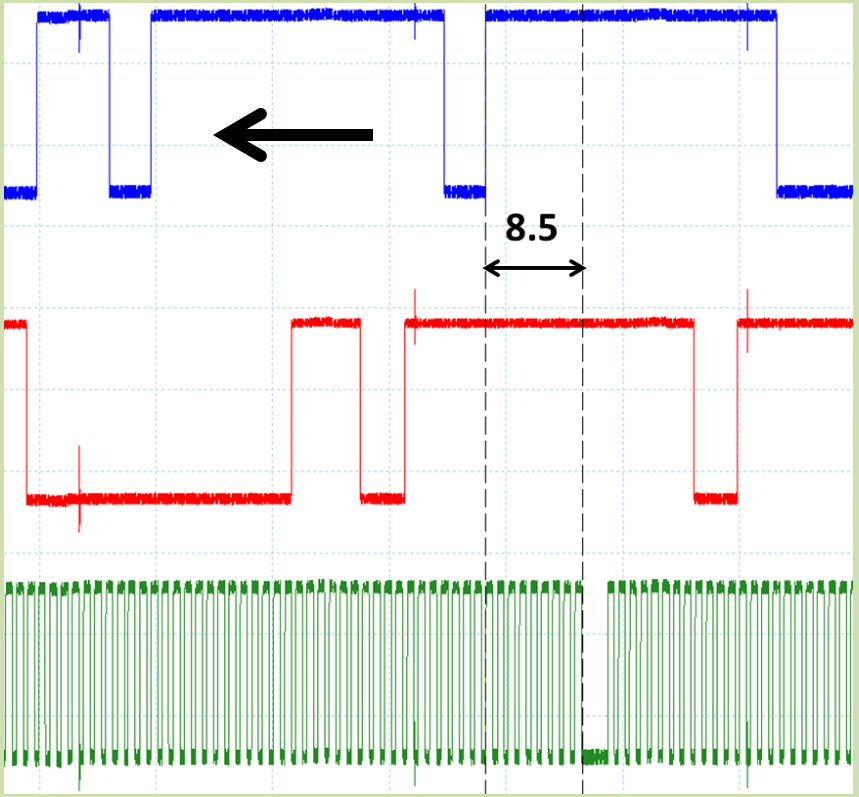


Phaser Style: Control Strategy

CKP vs. intake in blue @ idle



Intake @ full advance



Phaser Style: Control Strategy

Dyno Run video clip

Event Viewer REC_1C4BJWFG6CL218198_120919115413 - Wed Sep 19 11:54:13 CDT 2012

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

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 : dixo n 318 4v 12

Vehicle Information

VIN : 1[redacted]

Year / Body : 2012/JK

Engine : 3.6L

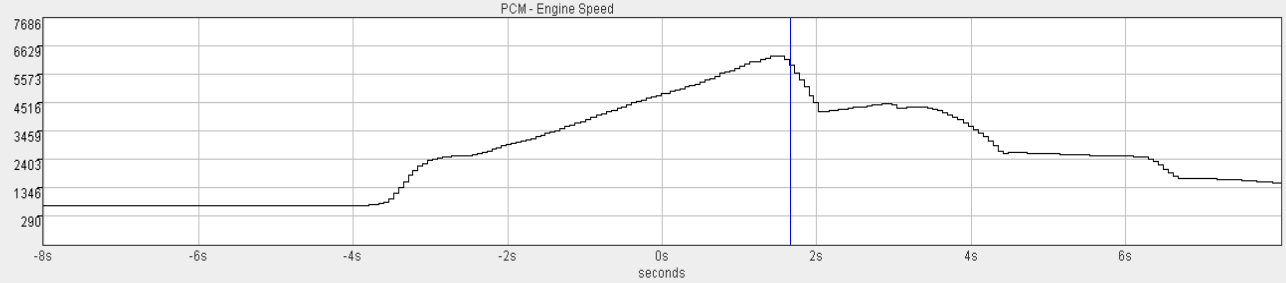
Control Panel

< Nudge | Time : 001.672 | Nudge >

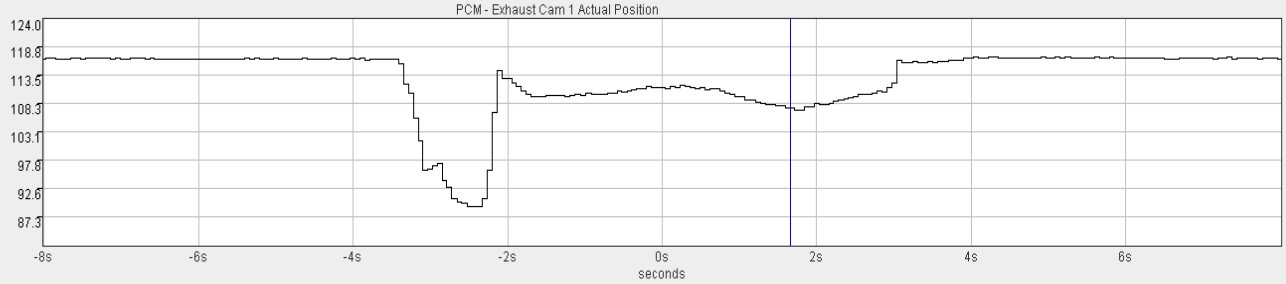
-30 ——— 30

Zoom In | Zoom Out | GoTo Trigger

Fit



Fit



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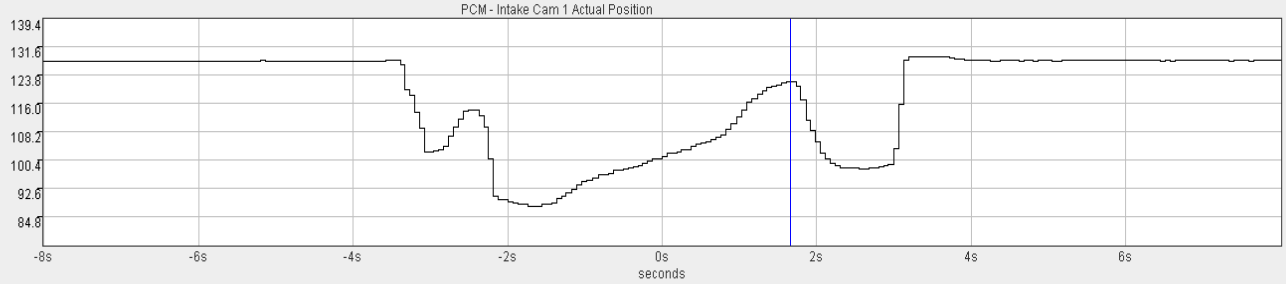
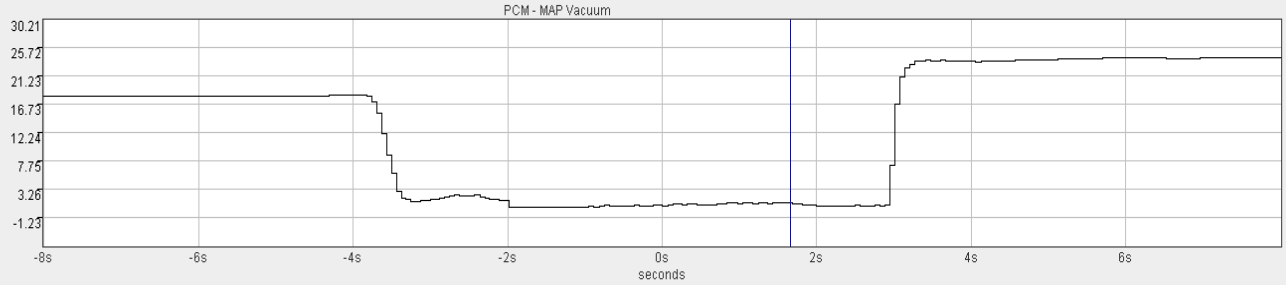


Fit



start | powerpoints | 13.01.26 | Event Viewer REC_1... | 2:56 PM

Event Viewer REC_1C4BJWFG6CL218198_120919115206 - Wed Sep 19 11:52:06 CDT 2012

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

2012 Wrangler 3.6
Mild acceleration

Select All | Deselect All

Event Recording

Template Name : dixon jc vvt test 9 19 12

Total Recording Time : 60

Recording File Comment : dixo n 318 4v 12

Vehicle Information

VIN : [redacted]

Year / Body : 2012/JK

Engine : 3.6L

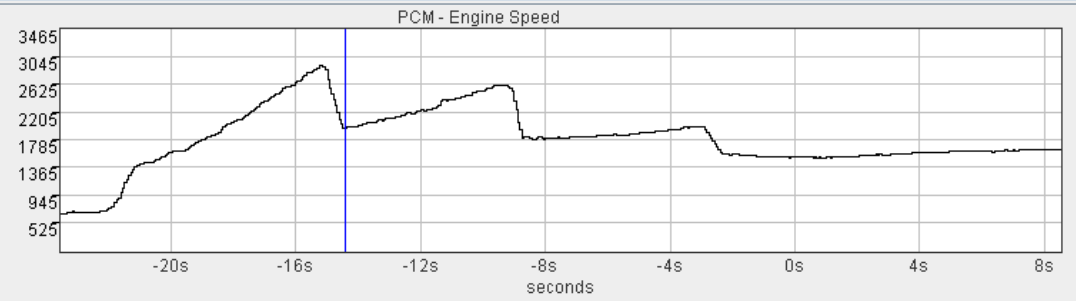
Control Panel

< Nudge | Time : -014.382 | Nudge >

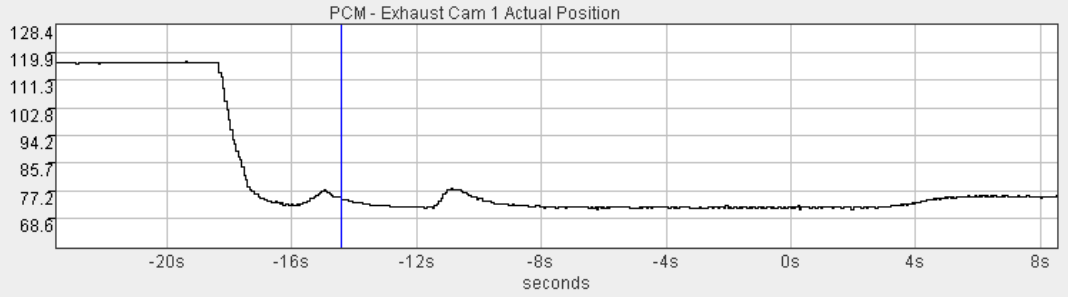
-30 — 30

Zoom In | Zoom Out | GoTo Trigger

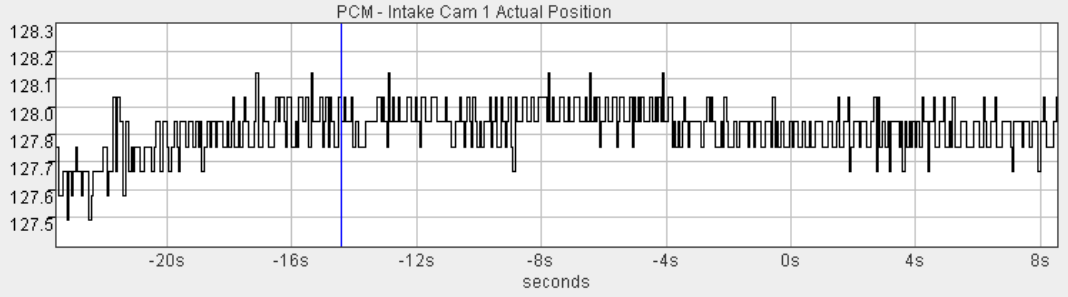
Fit



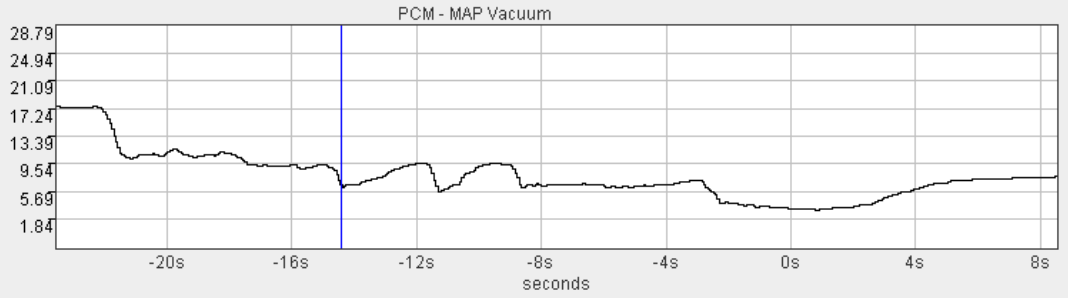
Fit



Fit



Fit



Event Viewer REC_1C4BJWFG6CL218198_120919115015 - Wed Sep 19 11:50:15 CDT 2012

Graph	ECU	Name	Value	Units
☐	PCM	APP 1 Volts	0.4448	Volts
☐	PCM	APP 2 Volts	0.2248	Volts
☑	PCM	Engine Speed	674	rpm
☑	PCM	Exhaust Cam 1 Actual Position	116.6	Engin...
☐	PCM	Exhaust Cam 1 Duty Cycle	0.0000	%DC
☐	PCM	Exhaust Cam 2 Desired Position	116.7	Engin...
☐	PCM	Exhaust Cam 2 Duty Cycle	0.0000	%DC
☐	PCM	Injector Pulse Width Cylinder 1	3464	US
☑	PCM	Intake Cam 1 Actual Position	127.9	Engin...
☐	PCM	Intake Cam 1 Duty Cycle	0.0000	%DC
☐	PCM	Intake Cam 2 Actual Position	127.0	Engin...
☐	PCM	Intake Cam 2 Duty Cycle	0.0000	%DC
☑	PCM	MAP Vacuum	15.52	in Hg
☐	PCM	Throttle Blade Position	3	%
☐	PCM	Vehicle Speed	2.0	MPH
☐	PCM	VVT Oil Pressure	28	psi
☐	PCM	VVT Oil Temp	176	F
☐	PCM	VVT Test Step Count Spec	9	Counts

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 : dixo n 318 4v 12

Vehicle Information

VIN : [redacted]

Year / Body : 2012/JK

Engine : 3.6L

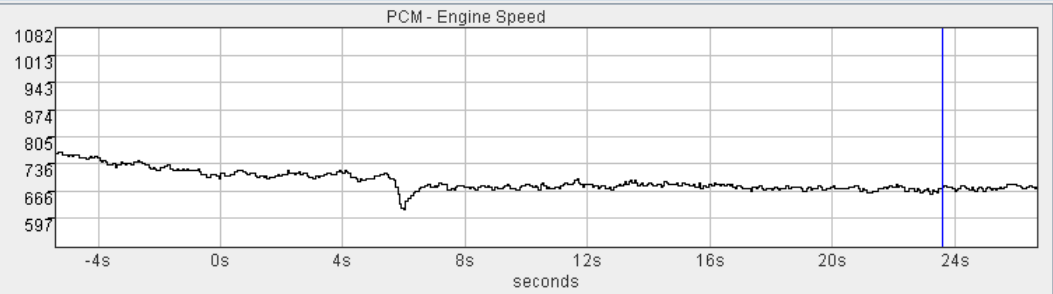
Control Panel

< Nudge | Time : 023.569 | Nudge >

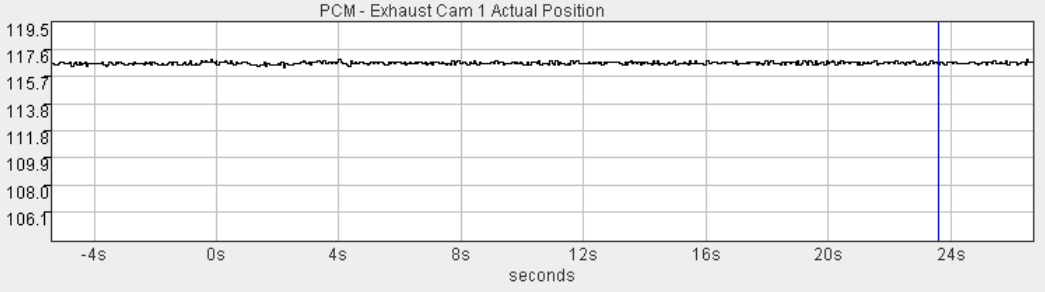
-30 ——— 30

Zoom In | Zoom Out | GoTo Trigger

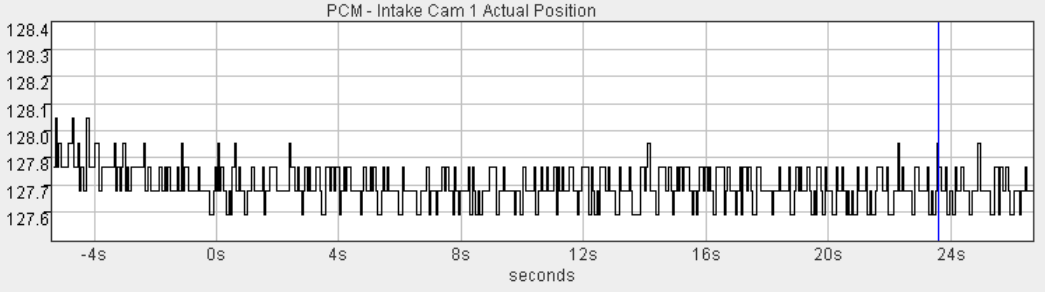
Fit



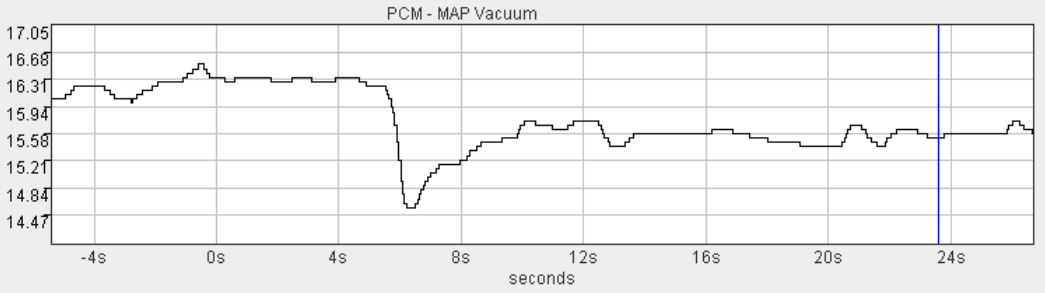
Fit



Fit



Fit



Event Viewer REC_1C4BJWFG6CL218198_120919115526 - Wed Sep 19 11:55:26 CDT 2012

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

2012 Wrangler 3.6
Decel, accel, light cruise

Select All | Deselect All

Event Recording

Template Name : dixon jc vvt test 9 19 12

Total Recording Time : 60

Recording File Comment : dixo n 318 4v 12

Vehicle Information

VIN : [redacted]

Year / Body : 2012/JK

Engine : 3.6L

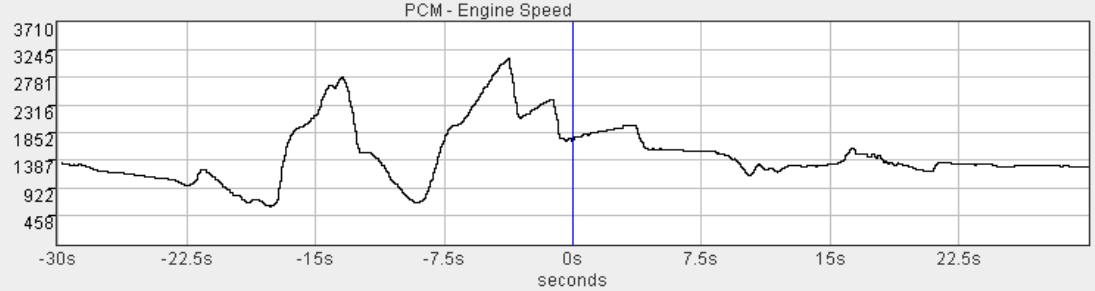
Control Panel

< Nudge | Time : 000.000 | Nudge >

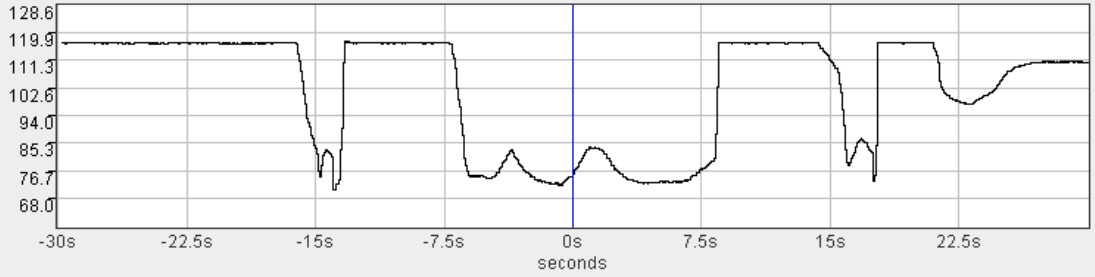
-30 — 30

Zoom In | Zoom Out | GoTo Trigger

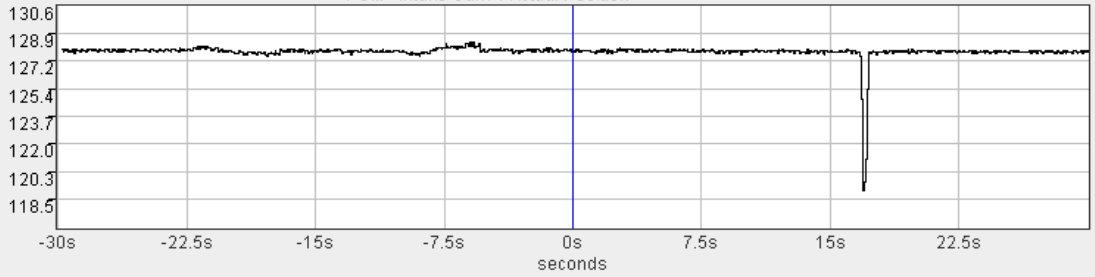
Fit



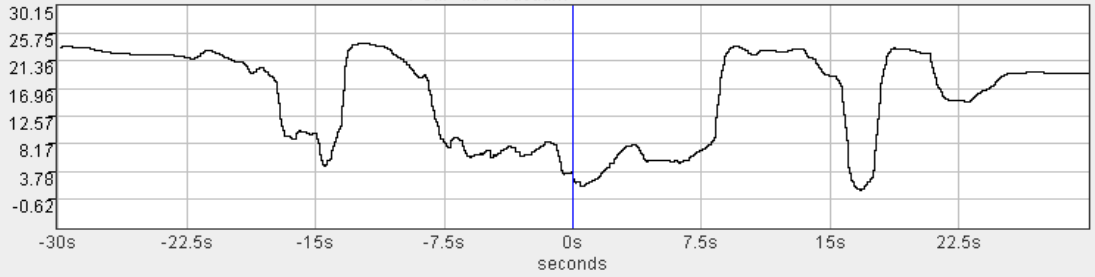
Fit



Fit



Fit



Event Viewer REC_1C3CDZDB1CN100072_120419174307 - Thu Apr 19 17:43:07 CDT 2012

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

2012 Avenger 2.4
WOT Run

Select All | Deselect All

Event Recording

Template Name : VVT Controls

Total Recording Time : 60

Recording File Comment : vvt78

Vehicle Information

VIN : [redacted]

Year / Body : 2012/JS

Engine : 2.4L

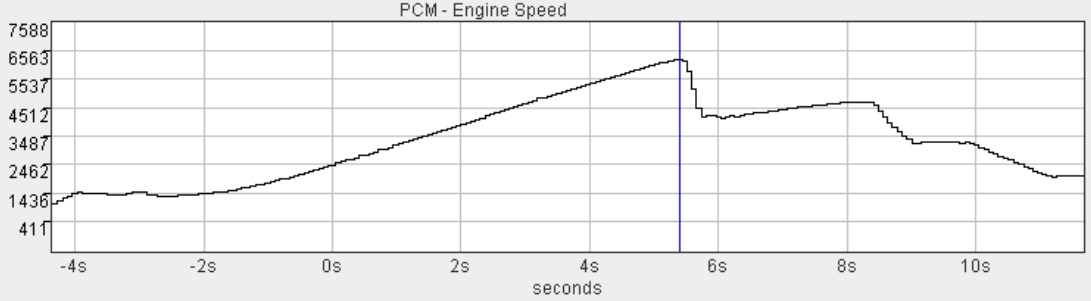
Control Panel

< Nudge | Time : 005.406 | Nudge >

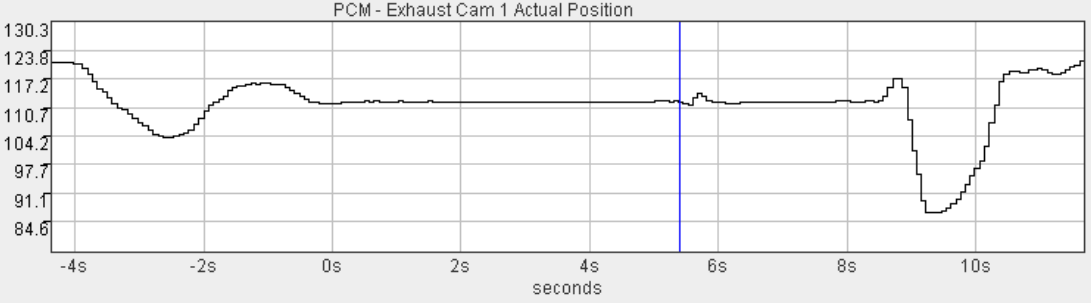
-30 — 30

Zoom In | Zoom Out | GoTo Trigger

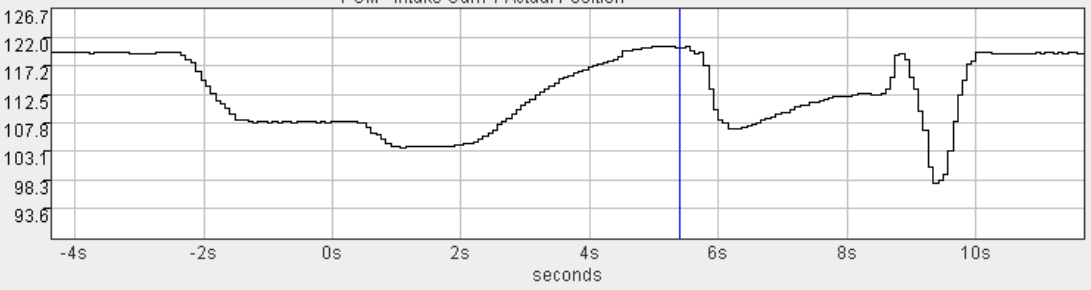
Fit



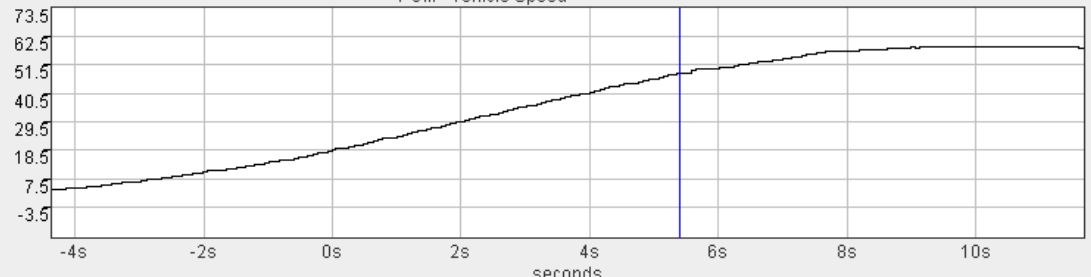
Fit



Fit



Fit



Event Viewer REC_1C3CDZDB1CN100072_120419174436 - Thu Apr 19 17:44:36 CDT 2012

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

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 : vvt78

Vehicle Information

VIN : [redacted]

Year / Body : 2012/JS

Engine : 2.4L

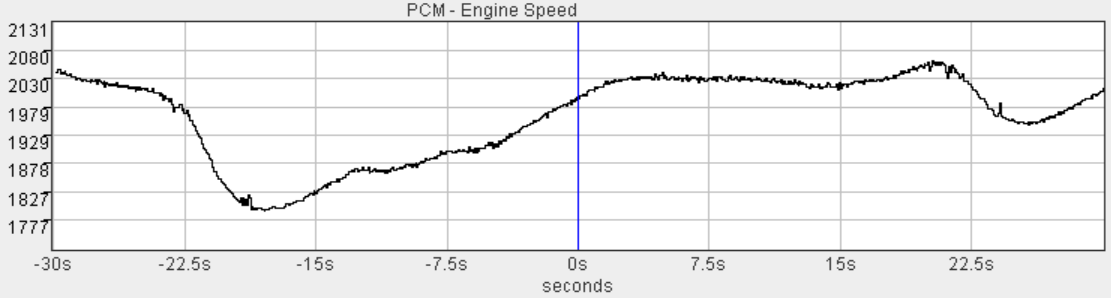
Control Panel

< Nudge | Time : 000.000 | Nudge >

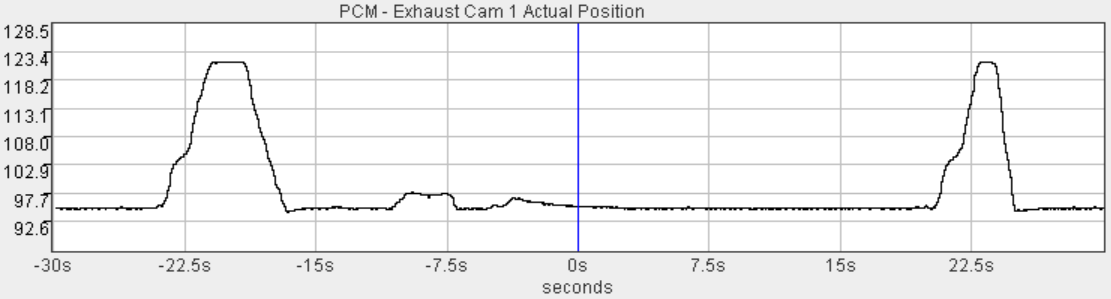
-30 — 30

Zoom In | Zoom Out | GoTo Trigger

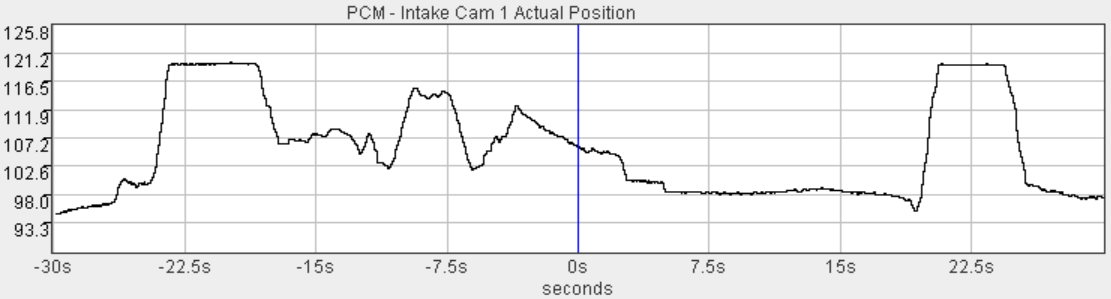
Fit



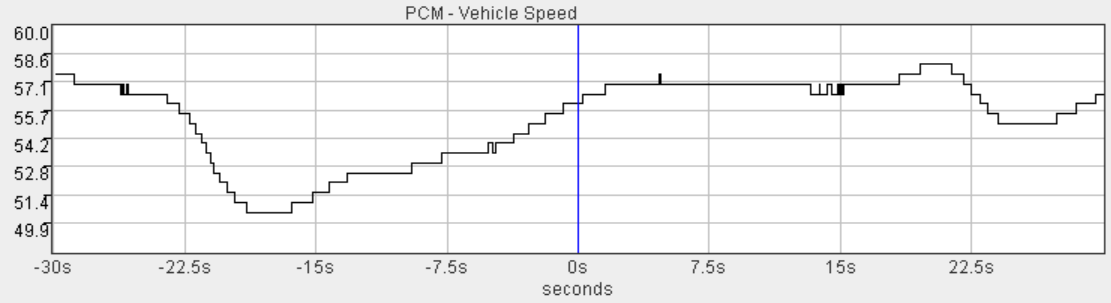
Fit



Fit



Fit



Event Viewer REC_1C3CDZDB1CN100072_120419174039 - Thu Apr 19 17:40:39 CDT 2012

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

2012 Avenger: mild accel, WOT, Decel

Select All | Deselect All

Event Recording

Template Name : VVT Controls

Total Recording Time : 60

Recording File Comment : vvt78

Vehicle Information

VIN : [redacted]

Year / Body : 2012/JS

Engine : 2.4L

Control Panel

< Nudge | Time : 000.000 | Nudge >

-30 — 30

Zoom In | Zoom Out | GoTo Trigger

Fit

PCM - Engine Speed

rpm: 7009, 6112, 5214, 4317, 3420, 2523, 1626, 728

-30s, -22.5s, -15s, -7.5s, 0s, 7.5s, 15s, 22.5s

seconds

Fit

PCM - Exhaust Cam 1 Actual Position

Engine Deg: 128.4, 123.2, 118.0, 112.8, 107.6, 102.3, 97.1, 91.9

-30s, -22.5s, -15s, -7.5s, 0s, 7.5s, 15s, 22.5s

seconds

Fit

PCM - Intake Cam 1 Actual Position

Engine Deg: 127.1, 121.7, 116.3, 110.9, 105.5, 100.1, 94.7, 89.3

-30s, -22.5s, -15s, -7.5s, 0s, 7.5s, 15s, 22.5s

seconds

Fit

PCM - Vehicle Speed

MPH: 89.5, 76.1, 62.6, 49.2, 35.8, 22.3, 8.9, -4.6

-30s, -22.5s, -15s, -7.5s, 0s, 7.5s, 15s, 22.5s

seconds

Event Viewer REC_1C3CDZDB1CN100072_120419173950 - Thu Apr 19 17:39:50 CDT 2012

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

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 : [redacted]

Year / Body : 2012/JS

Engine : 2.4L

Control Panel

< Nudge | Time : 005.897 | Nudge >

-30 — 30

Zoom In | Zoom Out | GoTo Trigger

Fit

PCM - Engine Speed

rpm

3728 3269 2809 2350 1891 1431 972 512

-30s -22.5s -15s -7.5s 0s 7.5s 15s 22.5s

seconds

Fit

PCM - Exhaust Cam 1 Actual Position

EngineDeg

129.1 123.4 117.8 112.1 106.4 100.8 95.1 89.5

-30s -22.5s -15s -7.5s 0s 7.5s 15s 22.5s

seconds

Fit

PCM - Intake Cam 1 Actual Position

EngineDeg

127.0 121.6 116.2 110.8 105.4 100.1 94.7 89.3

-30s -22.5s -15s -7.5s 0s 7.5s 15s 22.5s

seconds

Fit

PCM - Vehicle Speed

MPH

49.5 42.1 34.6 27.2 19.8 12.3 4.9 -2.6

-30s -22.5s -15s -7.5s 0s 7.5s 15s 22.5s

seconds

Event Viewer REC_2C3CDYBT2CH148100_120419100902 - Thu Apr 19 10:09:02 CDT 2012

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

'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 : [redacted]

Year / Body : 2012/LC

Engine : 5.7L

Control Panel

< Nudge | Time : -002.226 | Nudge >

-30 ——— 30

Zoom In | Zoom Out | GoTo Trigger

Fit

PCM - Engine Speed

rpm

8160 7140 6120 5100 4080 3060 2040 1020

-30s -22.5s -15s -7.5s 0s 7.5s 15s 22.5s

seconds

Fit

PCM - Exhaust Cam 1 Actual Position

EngineDeg

134.5 127.4 120.3 113.3 106.2 99.1 92.1 85.0

-30s -22.5s -15s -7.5s 0s 7.5s 15s 22.5s

seconds

Fit

PCM - MAP Vacuum

inHg

31.74 27.03 22.32 17.60 12.89 8.18 3.47 -1.25

-30s -22.5s -15s -7.5s 0s 7.5s 15s 22.5s

seconds

Fit

PCM - Vehicle Speed

MPH

75.5 64.9 54.2 43.6 33.0 22.4 11.8 1.1

-30s -22.5s -15s -7.5s 0s 7.5s 15s 22.5s

seconds

Event Viewer REC_2C3CDYBT2CH148100_120419101004 - Thu Apr 19 10:10:04 CDT 2012

Graph	ECU	Name	Value	Units
☐	PCM	1/1 O2 Sensor Volts	3.3385	Volts
☐	PCM	2/1 O2 Sensor Volts	2.6688	Volts
☐	PCM	Actual Torque	78.32	Ft-Lbs
☑	PCM	Engine Speed	2070	rpm
☐	PCM	Exhaust Cam 1 / Crank Difference	-35.6	Engin...
☑	PCM	Exhaust Cam 1 Actual Position	87.7	Engin...
☐	PCM	Exhaust Cam 1 Desired Position	87.9	Engin...
☐	PCM	Exhaust Cam 1 Duty Cycle	40.1765	%DC
☐	PCM	Exhaust Cam 1 Position Error	0.0	Engin...
☐	PCM	Exhaust Cam 2 Actual Position	0.0	Engin...
☐	PCM	Exhaust Cam 2 Desired Position	0.0	Engin...
☐	PCM	Exhaust Cam 2 Position Error	0.0	Engin...
☑	PCM	MAP Vacuum	16.58	in Hg
☐	PCM	Spark Advance	28.5	Engin...
☐	PCM	Spark Advance 1	-35.5	degr...
☐	PCM	ST Knock Retard	0.0	degr...
☐	PCM	Throttle Blade Position	9	%
☐	PCM	TPS 1 Volts	0.9479	Volts
☑	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 : [redacted]

Year / Body : 2012/LC

Engine : 5.7L

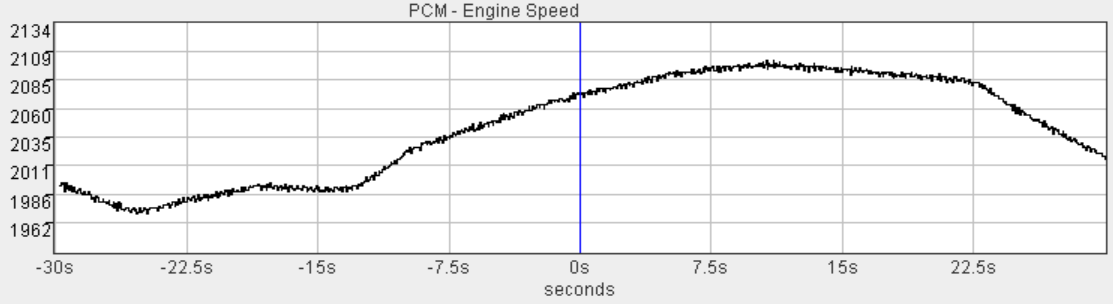
Control Panel

< Nudge | Time : 000.000 | Nudge >

-30 — 30

Zoom In | Zoom Out | GoTo Trigger

Fit



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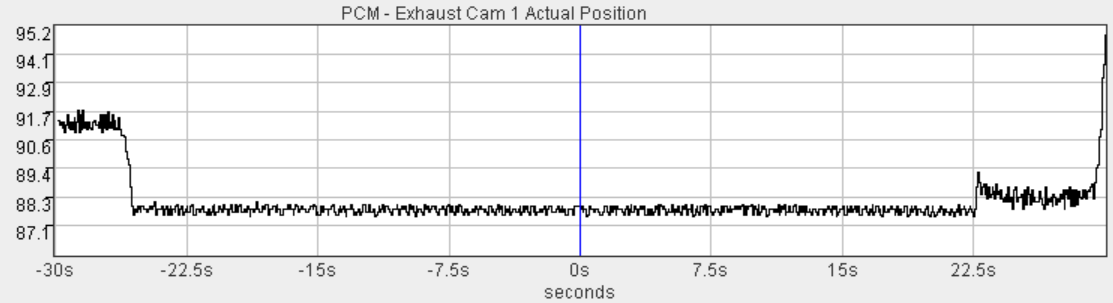

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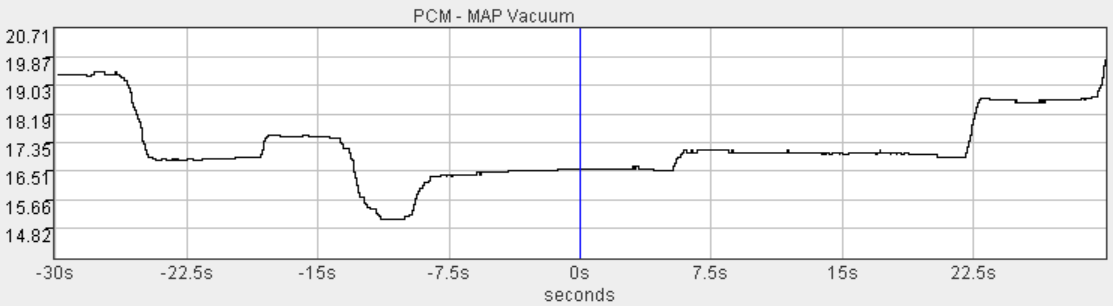

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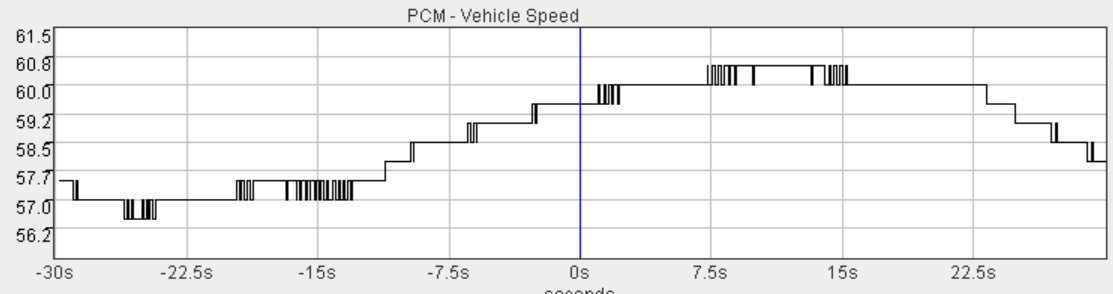


Event Viewer REC_2C3CDYBT2CH148100_120419101214 - Thu Apr 19 10:12:14 CDT 2012

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

‘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 : [redacted]

Year / Body : 2012/LC

Engine : 5.7L

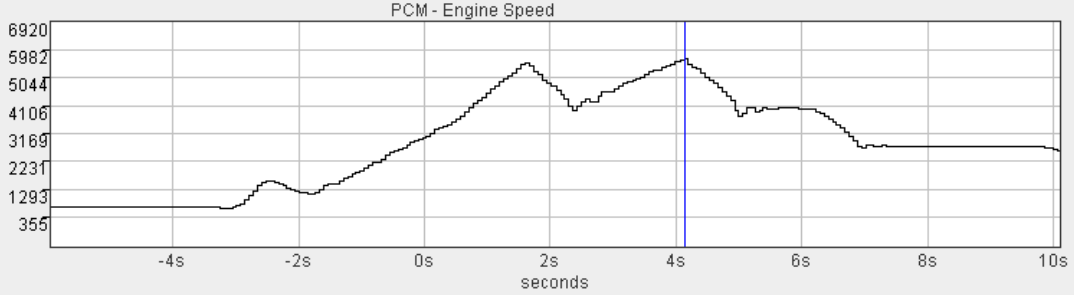
Control Panel

< Nudge | Time : 004.134 | Nudge >

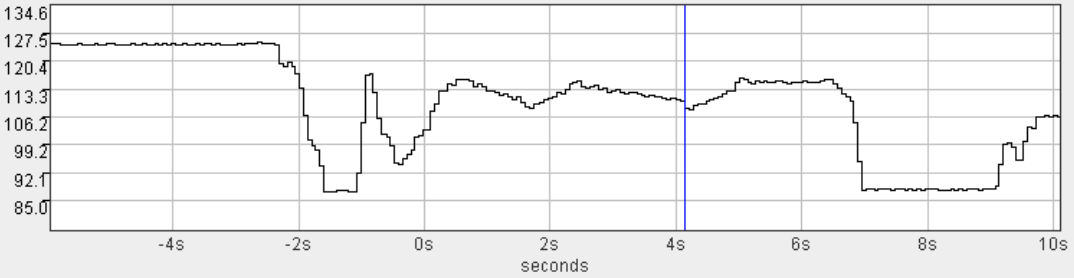
-30 — 30

Zoom In | Zoom Out | GoTo Trigger

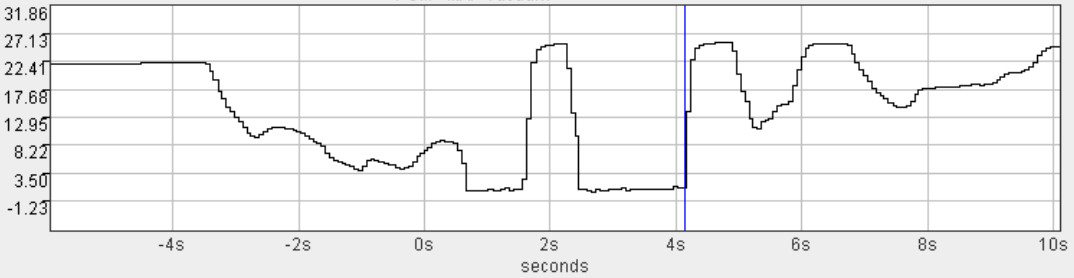
Fit



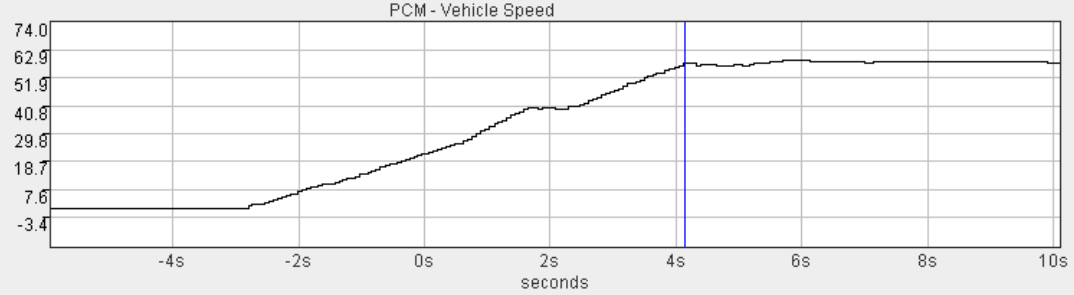
Fit



Fit



Fit



Event Viewer REC_2C3CDYBT2CH148100_120419101612 - Thu Apr 19 10:16:12 CDT 2012

Graph	ECU	Name	Value	Units
☐	PCM	1/1 O2 Sensor Volts	3.3141	Volts
☐	PCM	2/1 O2 Sensor Volts	3.3238	Volts
☐	PCM	Actual Torque	-1.24	Ft-Lbs
☑	PCM	Engine Speed	702	rpm
☐	PCM	Exhaust Cam 1 / Crank Difference	1.0	Engin...
☑	PCM	Exhaust Cam 1 Actual Position	124.7	Engin...
☐	PCM	Exhaust Cam 1 Desired Position	124.9	Engin...
☐	PCM	Exhaust Cam 1 Duty Cycle	0.0000	%DC
☐	PCM	Exhaust Cam 1 Position Error	0.0	Engin...
☐	PCM	Exhaust Cam 2 Actual Position	0.0	Engin...
☐	PCM	Exhaust Cam 2 Desired Position	0.0	Engin...
☐	PCM	Exhaust Cam 2 Position Error	0.0	Engin...
☑	PCM	MAP Vacuum	22.48	in Hg
☐	PCM	Spark Advance	15.5	Engin...
☐	PCM	Spark Advance 1	-48.5	degr...
☐	PCM	ST Knock Retard	0.0	degr...
☐	PCM	Throttle Blade Position	2	%
☐	PCM	TPS 1 Volts	0.5978	Volts
☑	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 : 2012/LC

Engine : 5.7L

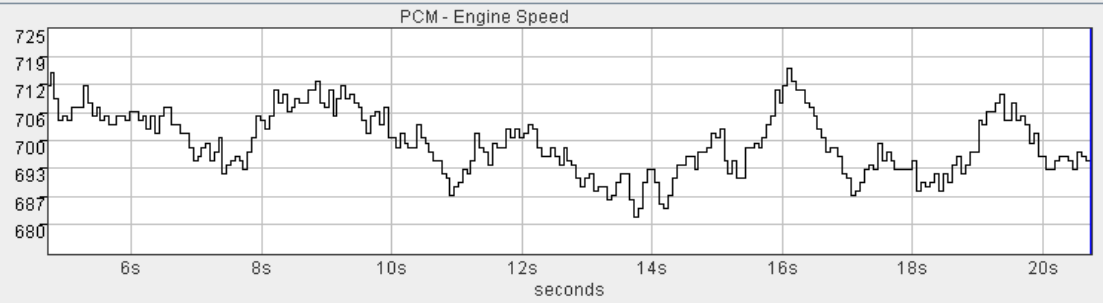
Control Panel

< Nudge | Time : 020.742 | Nudge >

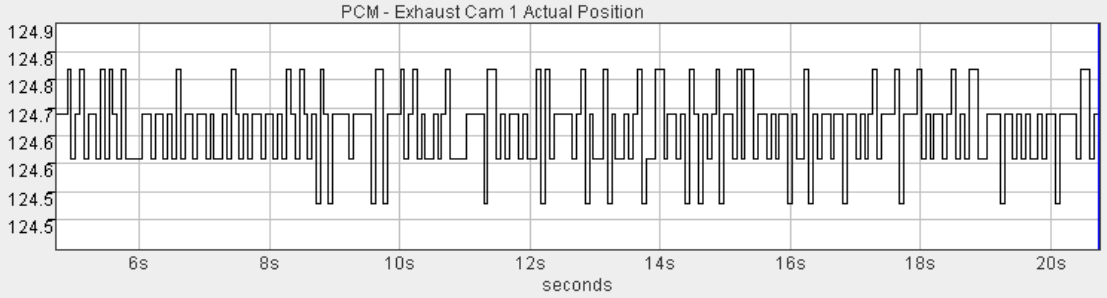
-30 — 30

Zoom In | Zoom Out | GoTo Trigger

Fit



Fit



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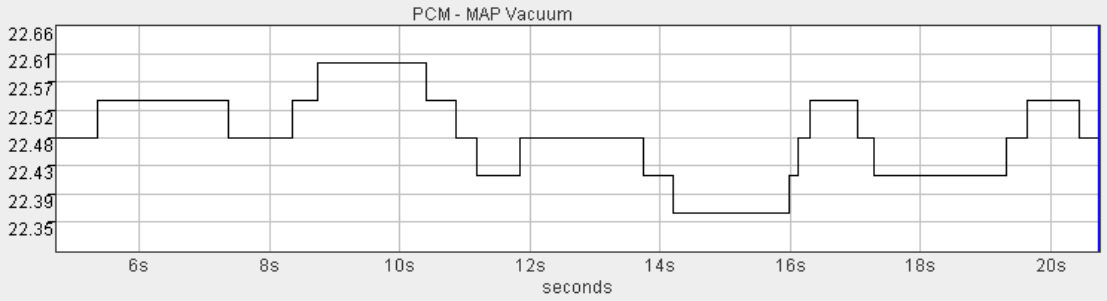
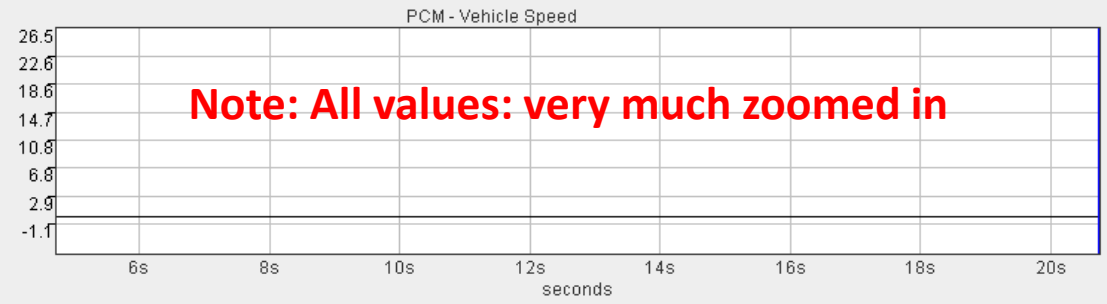


Fit



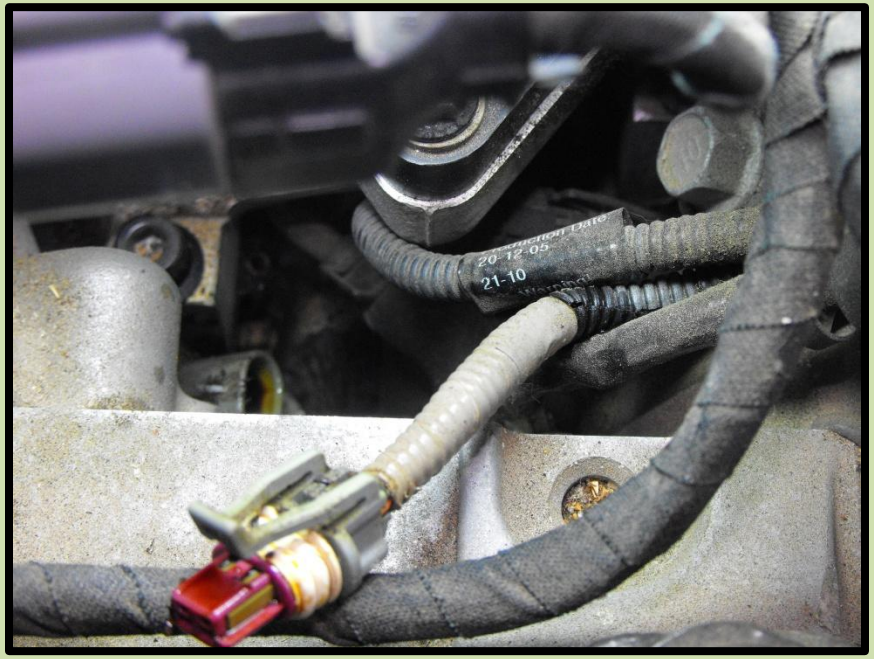
Note: All values: very much zoomed in

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

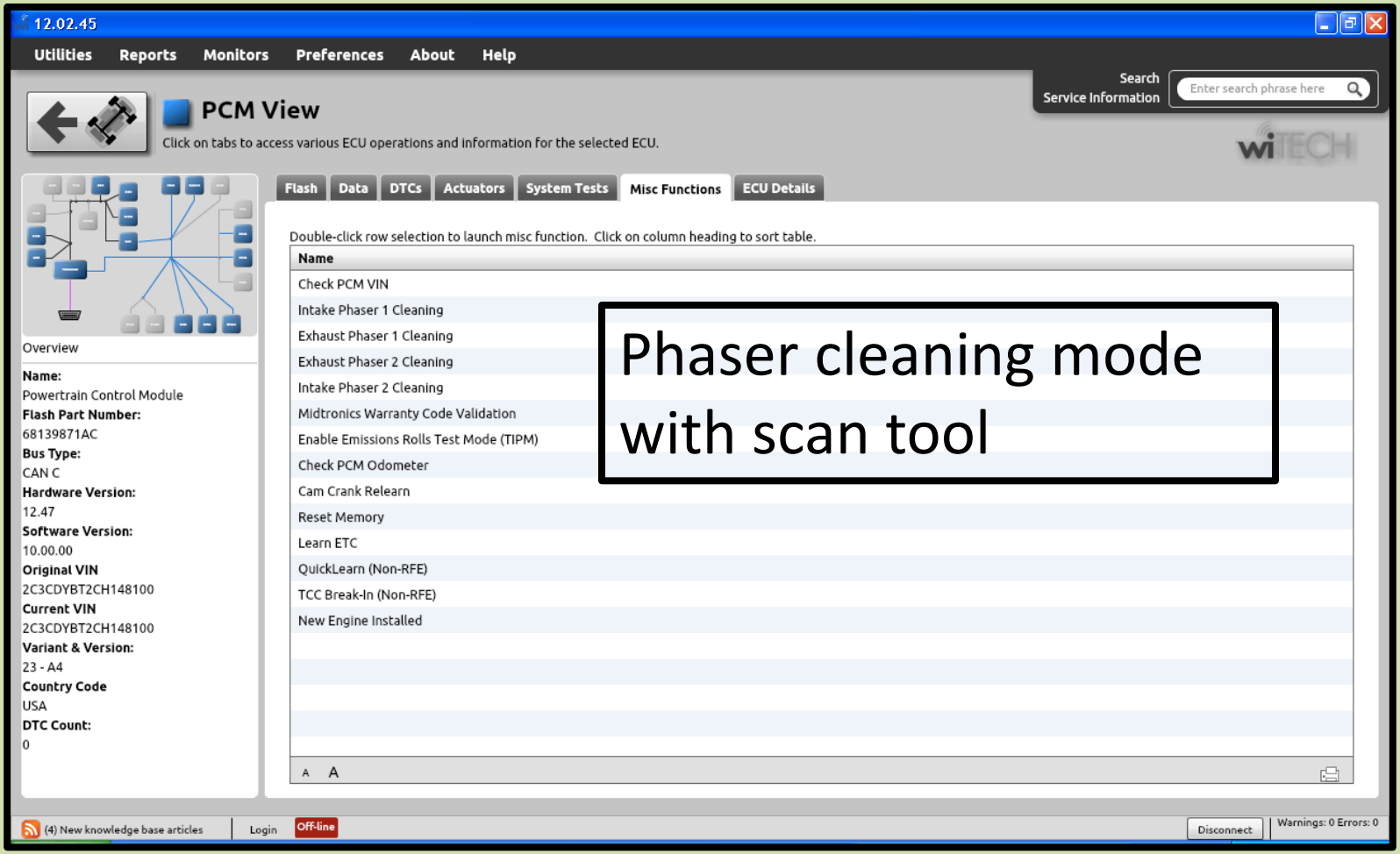
Phaser Style: Troubleshooting

2307 intake variance video clip

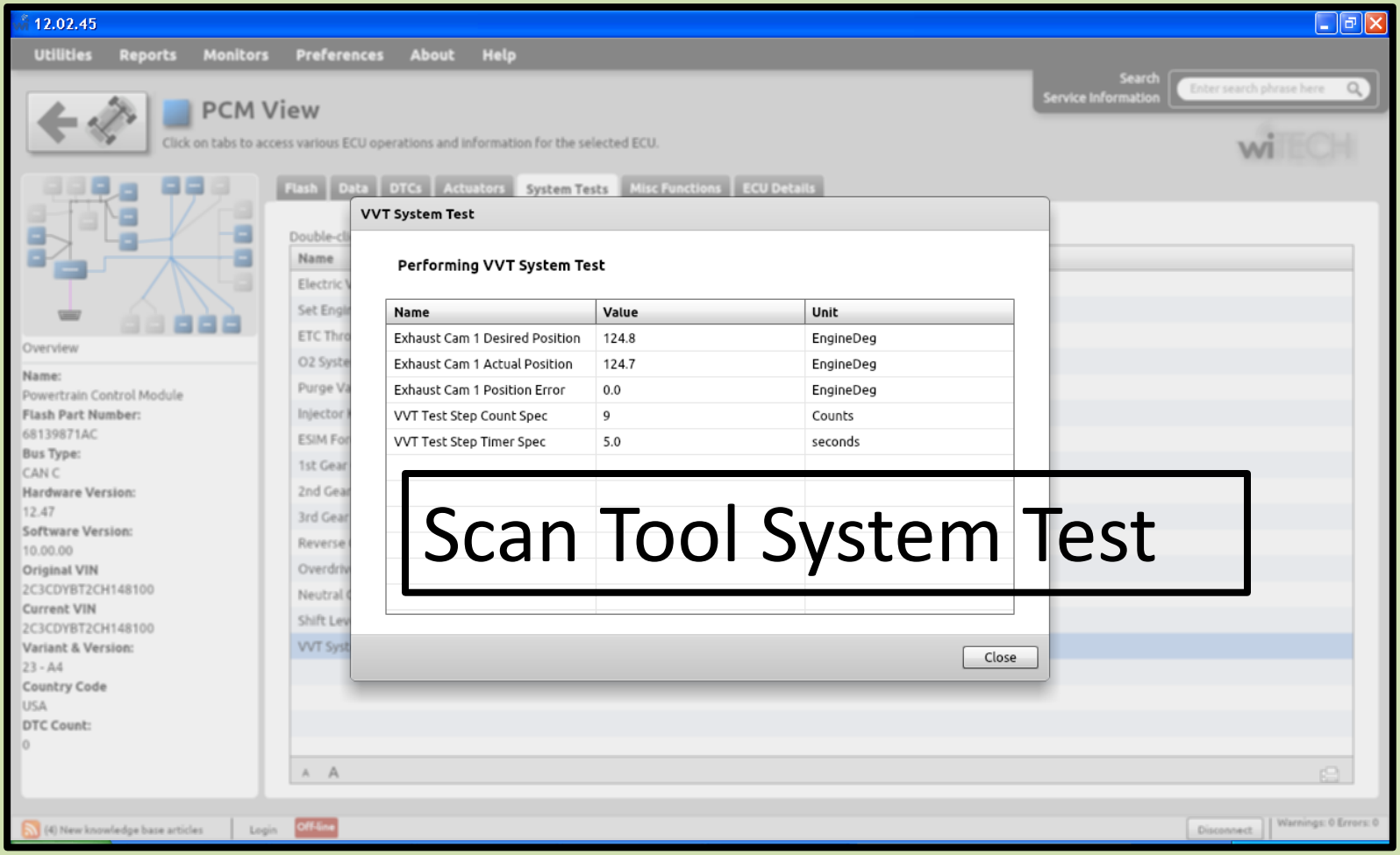
Phaser Style: Troubleshooting

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



Phaser Style: Troubleshooting



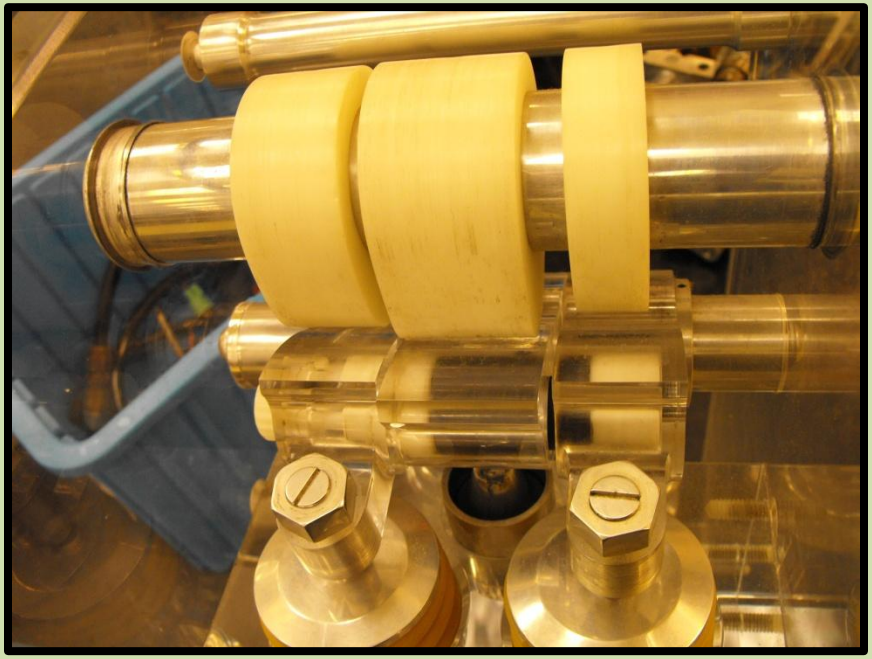
Lobe Switching Style

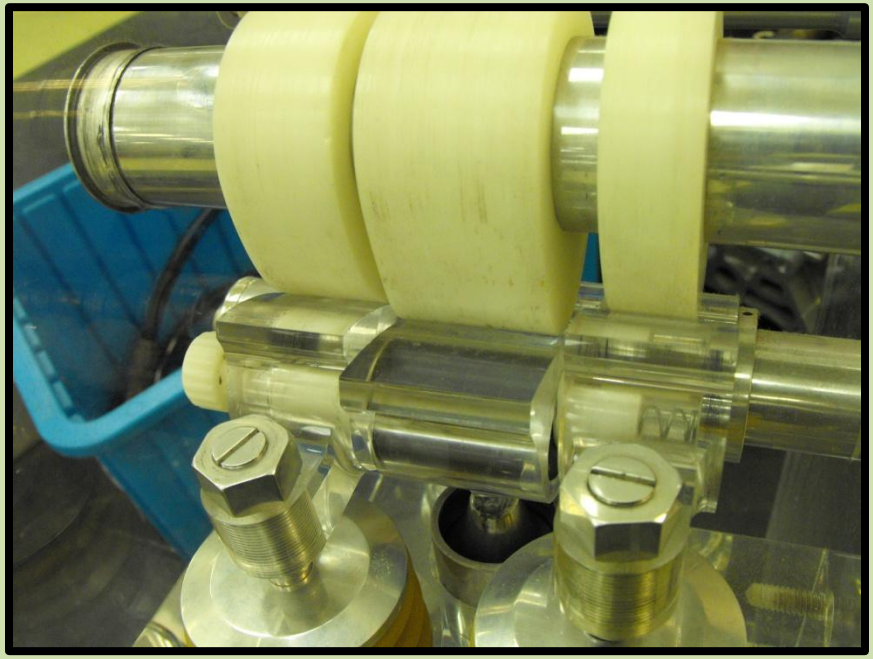
- Use of different cam lobes to control valves Mitsubishi **MIVEC** and Honda **VTEC**

- 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



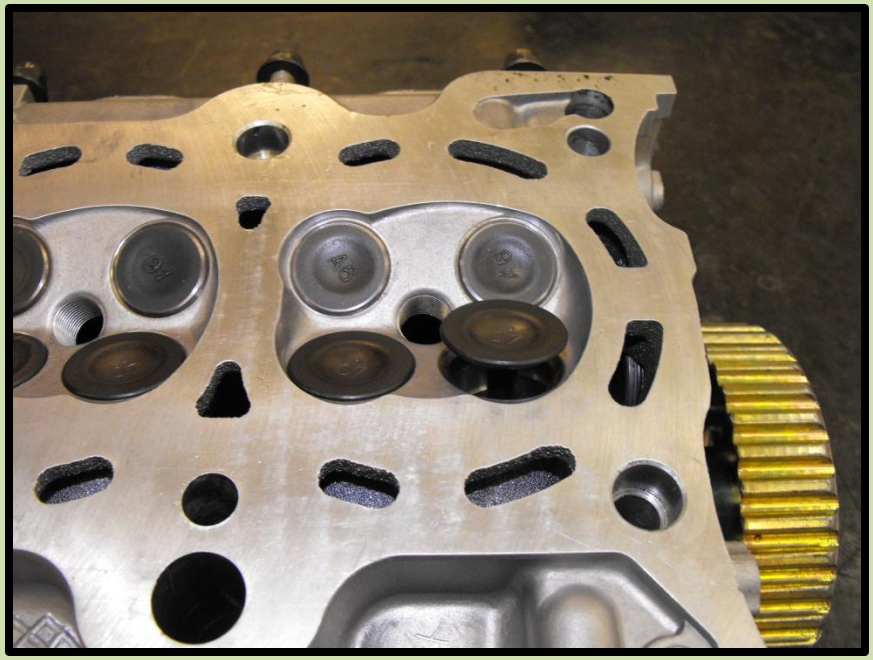


Honda VTEC mock up: depicts rockers connecting/ disconnecting

Lobe Switching Style

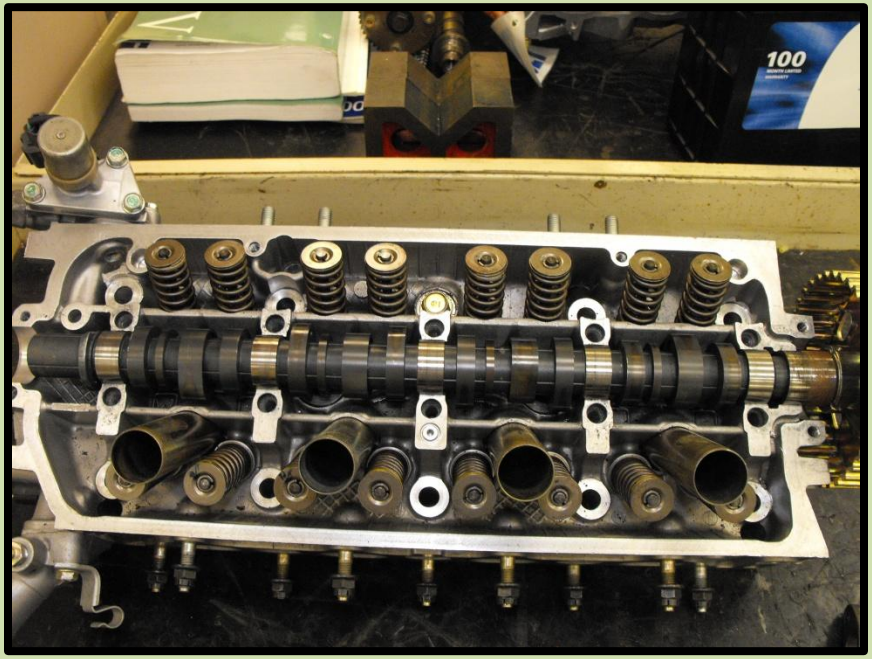
There are many VTEC versions, used to:

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

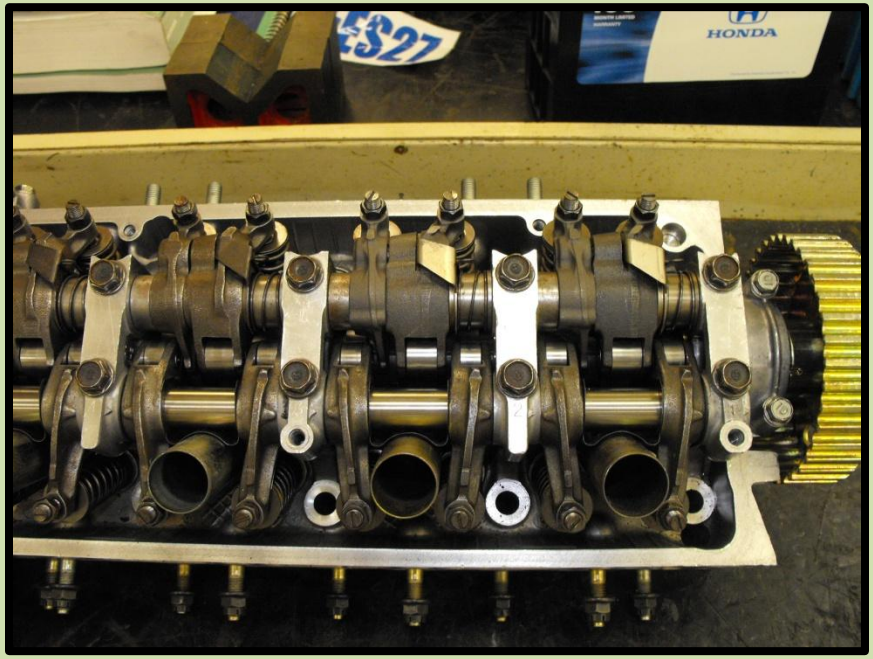


4 valve head, one intake nearly closed, improves low RPM swirl

Lobe Switching Style

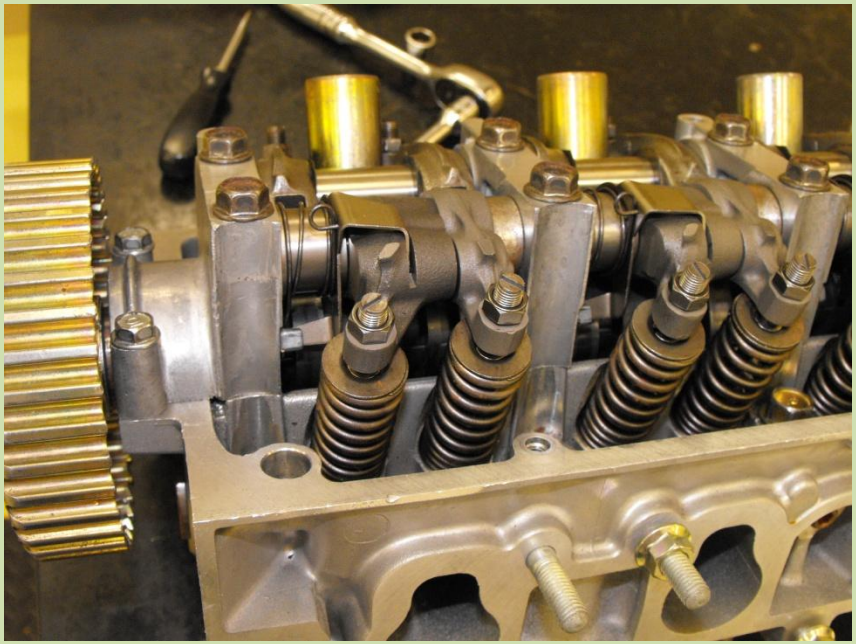


Camshaft: note multiple lobes

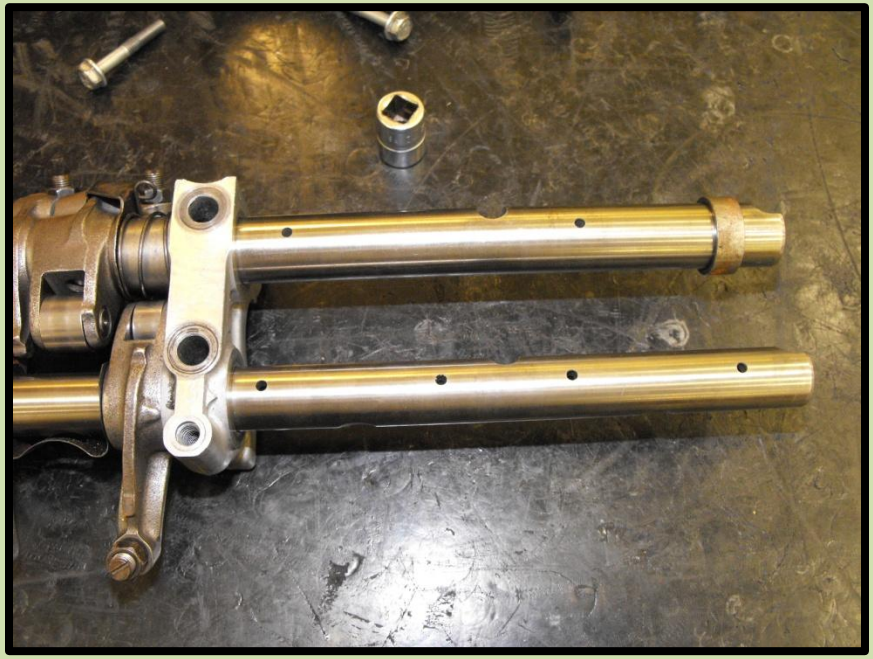


On this “D” series, VTEC intake only: note rockers towards top

Lobe Switching Style

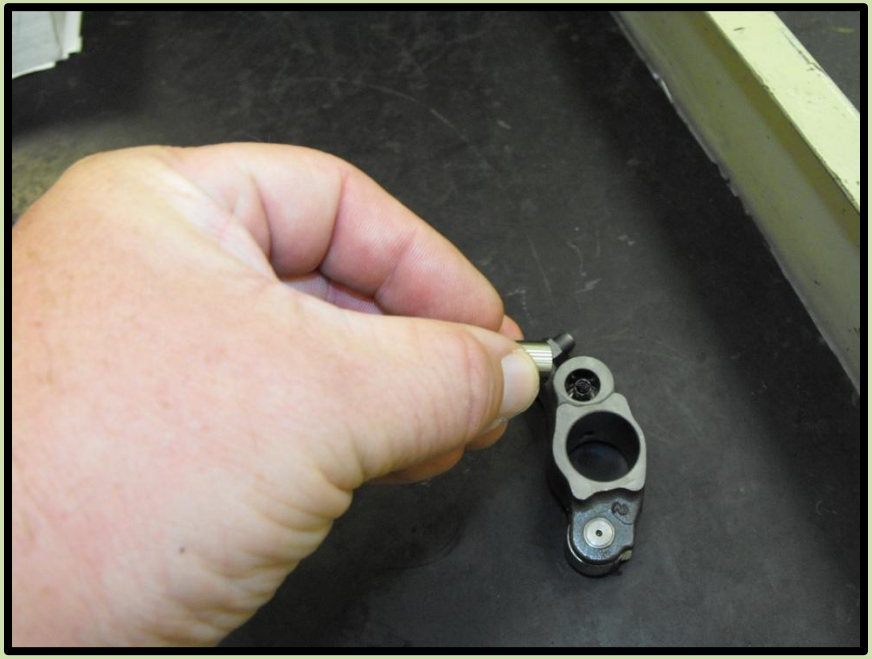


VTEC on intake, note: adjustable valves



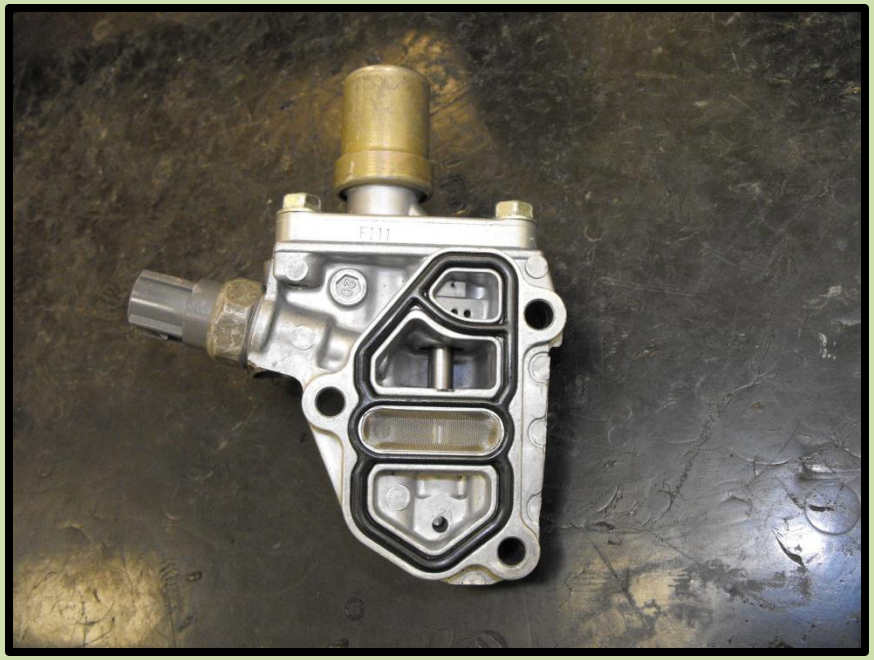
Rockers shafts: oil passage holes

Lobe Switching Style

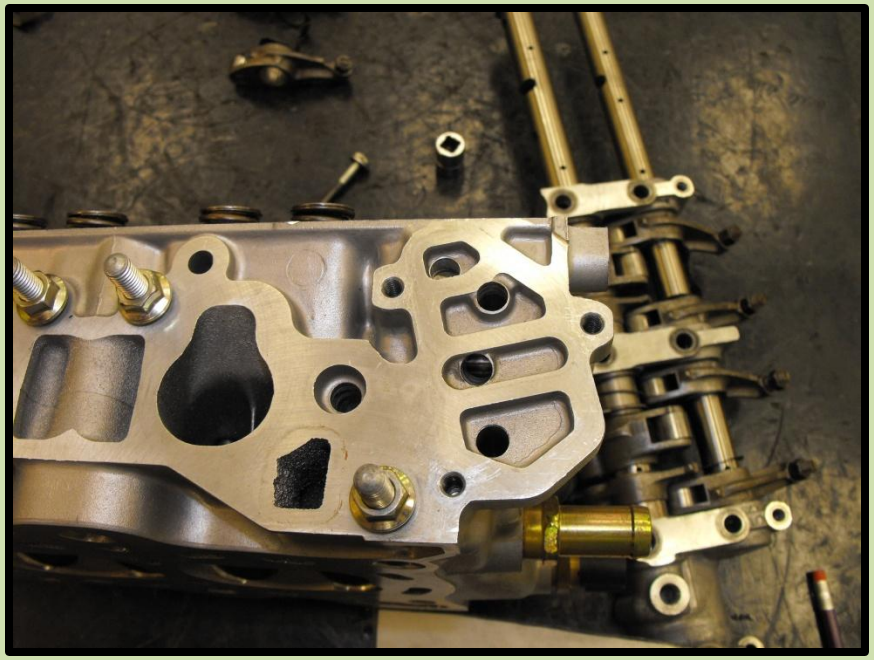


Rockers for the intake valves, lock pin, spring, timing piston

Lobe Switching Style



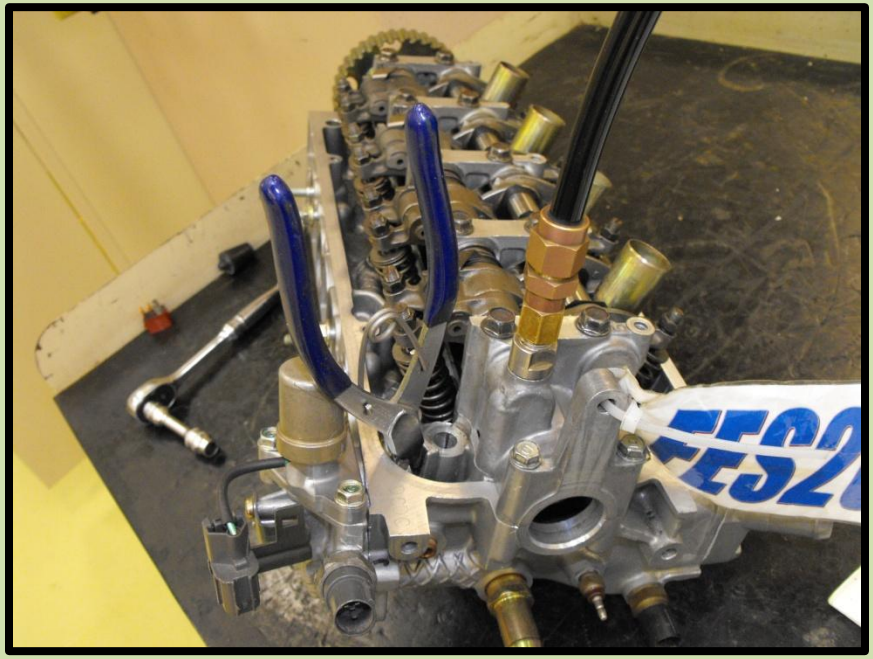
Oil control solenoid & pressure switch



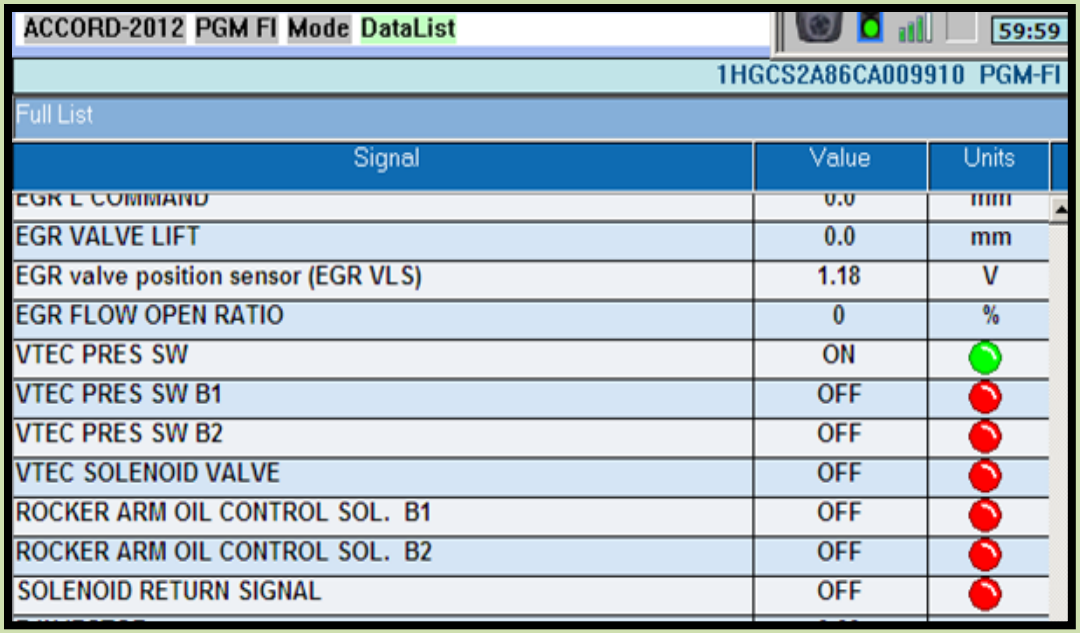
Head casting with oil passages to solenoid assembly

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

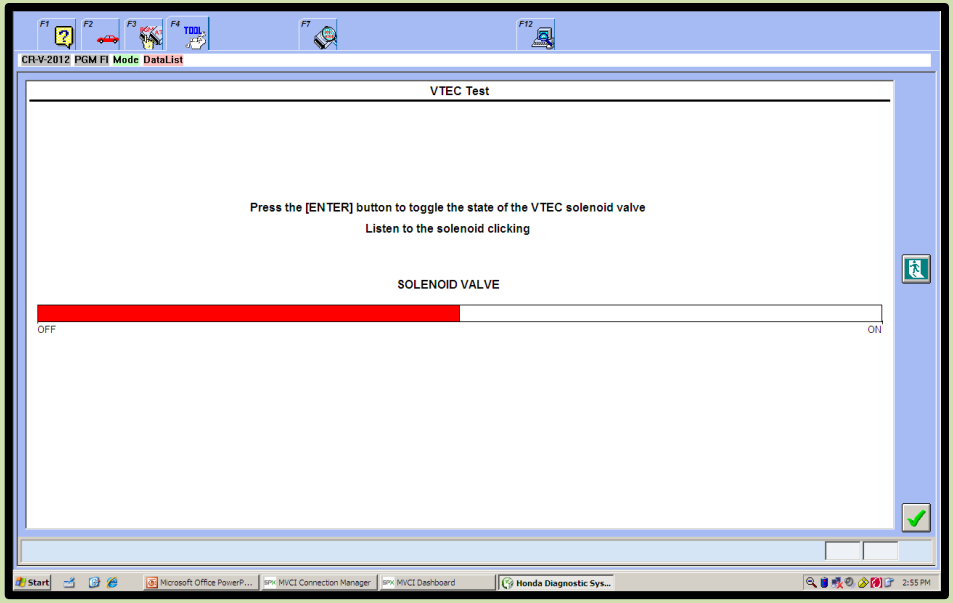


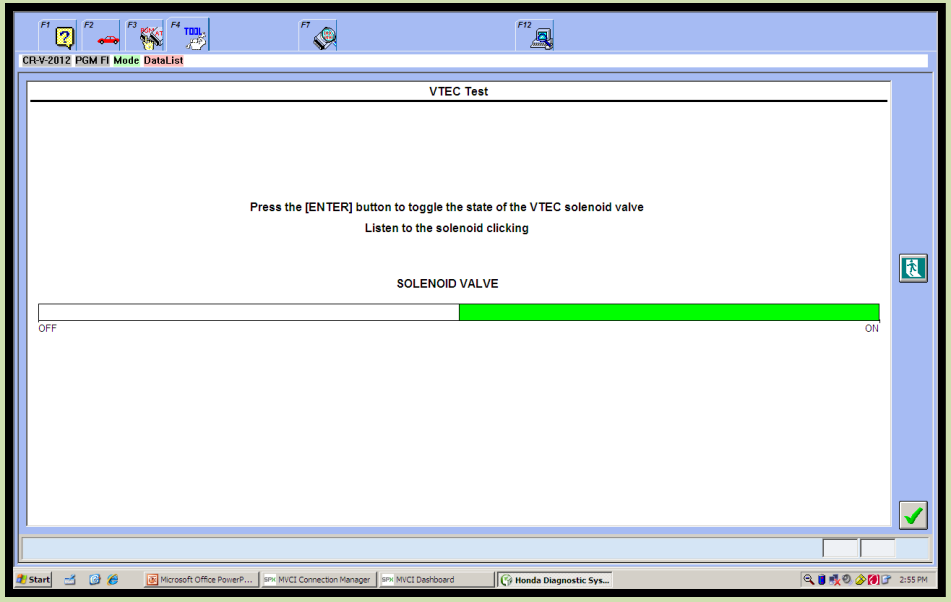
Lobe Switching Style



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

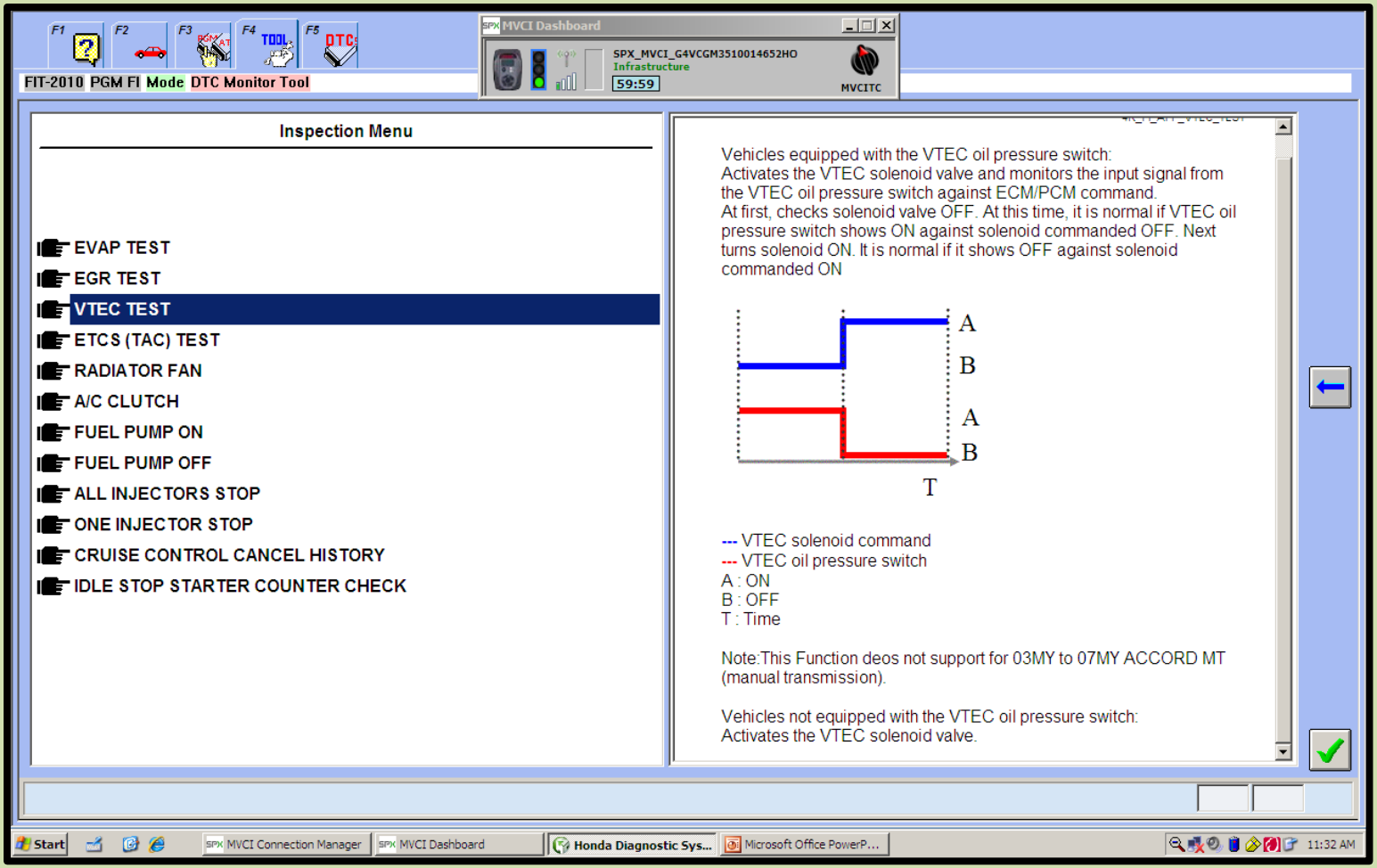
Lobe Switching style





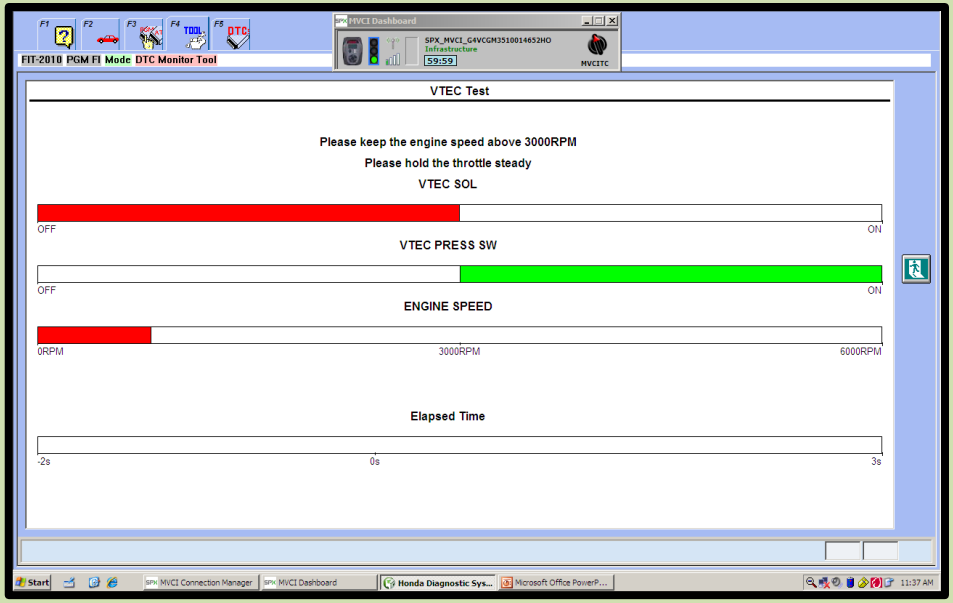
Inspection mode: actuate the VTEC solenoid

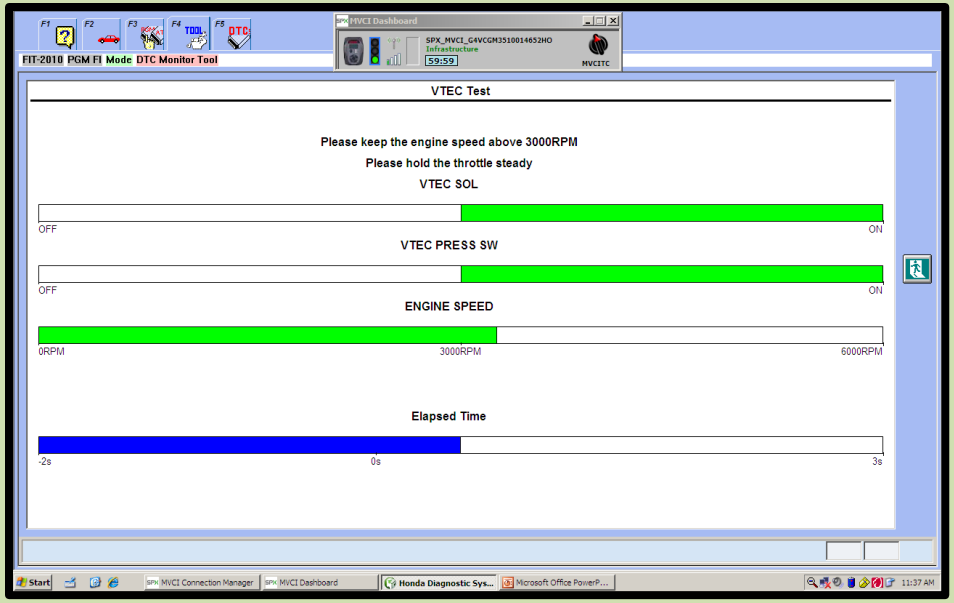
Lobe Switching Style



Opposite states: Pressure switch vs. VTEC solenoid

Lobe Switching Style

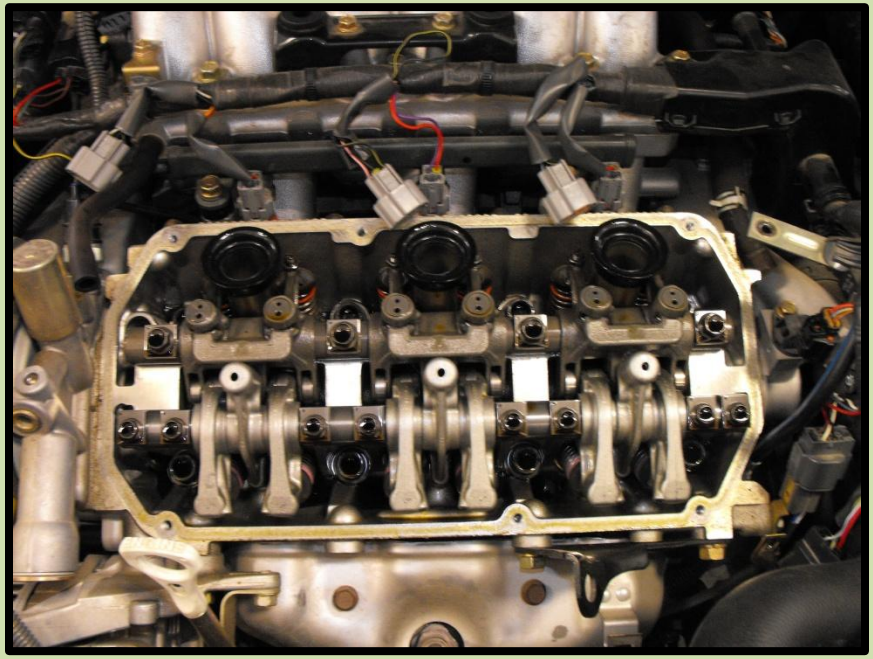




Scan tool VTEC test

Lobe Switching style

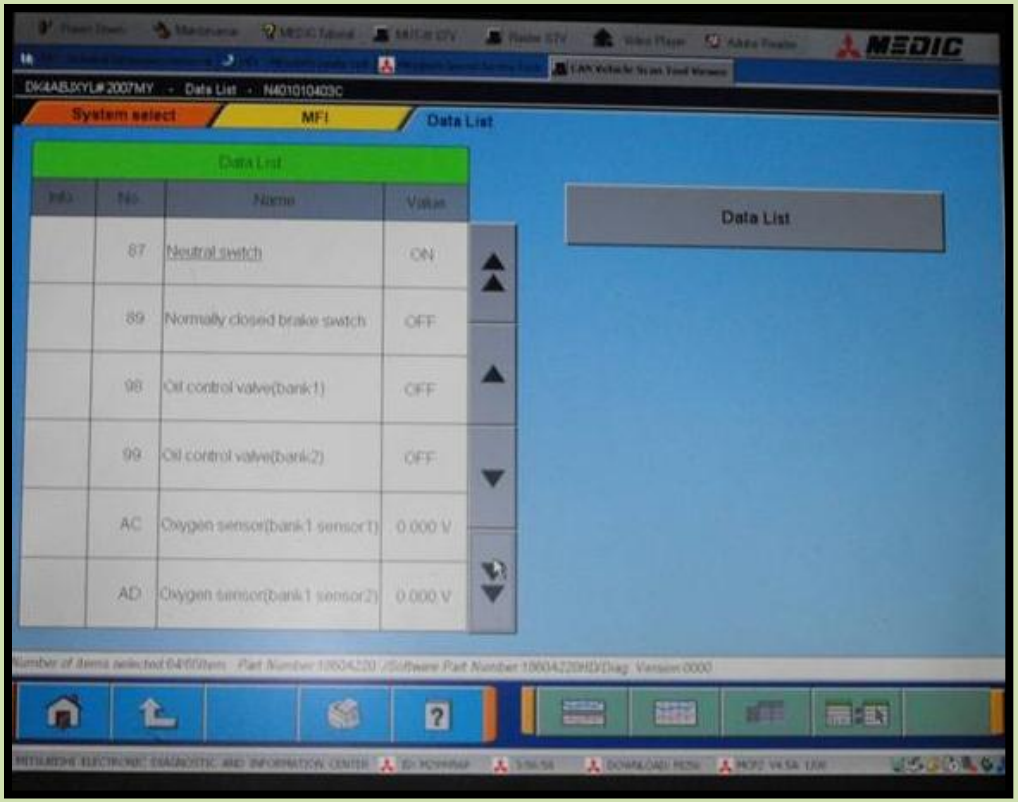
- Mitsubishi MIVEC uses similar rocker arm connections to switch between camshaft lobes



3.8 V-6 bank 2, intake towards top

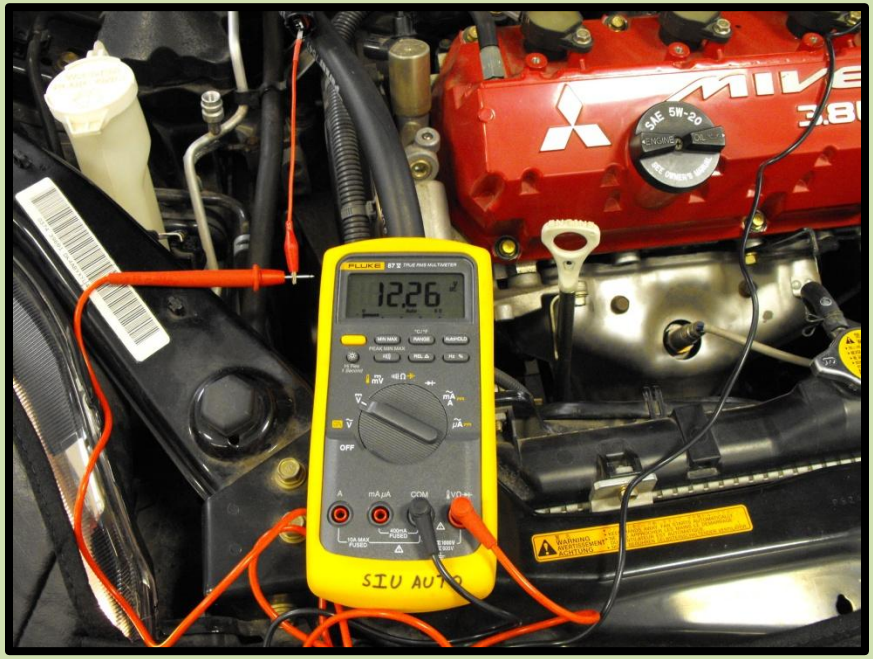
Lobe Switching style

- 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