

# SenX™ Technology

## FirstLook™ Pulse Sensor

- FAST AND EASY HOOK UP
- LOCATE PROBLEM CYLINDERS THRU EXHAUST SYSTEM PULSES.
- COLD CRANK ENGINE TEST DETERMINES CORE ENGINE PROBLEMS- VALVE LEAKAGE, CYLINDER COMPRESSION.
- HOOK UP TO FUEL PRESSURE REGULATOR AND CHECK FOR INJECTOR PROBLEMS.

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Update 7/28/04

# Taking The Pulse of Your Engine

Congratulations on your purchase of the *FirstLook*<sup>™</sup> automotive engine diagnostic sensor. This is your first step down a road of easier and more accurate engine diagnostics. With *FirstLook* you can now have a more complete picture of an engine's performance, quickly and easily. Once you have learned to use the sensor combined with the timing chart you will be able to find burnt valves, bad injectors and other engine performance problems without major disassembly of the engine...and in a fraction of the time currently required. Consider how long it may take just to remove spark plugs to perform a compression test on today's engines.

# Taking The Pulse of Your Engine

- *FirstLook* is unique because it looks at pulses in engine airflow, allowing you to display “the pulse of your engine” on standard scope equipment. While scanners interrupt the information they receive from engine sensors and engine analyzers tell us what the ignition system is doing, it is difficult to see what was *actually* happening in the engine without intrusive tests. With *FirstLook* in your diagnostic arsenal it will now be possible to see what is dynamically occurring in your engine. Although this user's guide will focus on automobile combustion engines, the FirstLook sensor may also be used with other gasoline and diesel four stroke engines.

# PACKAGE CONTENTS



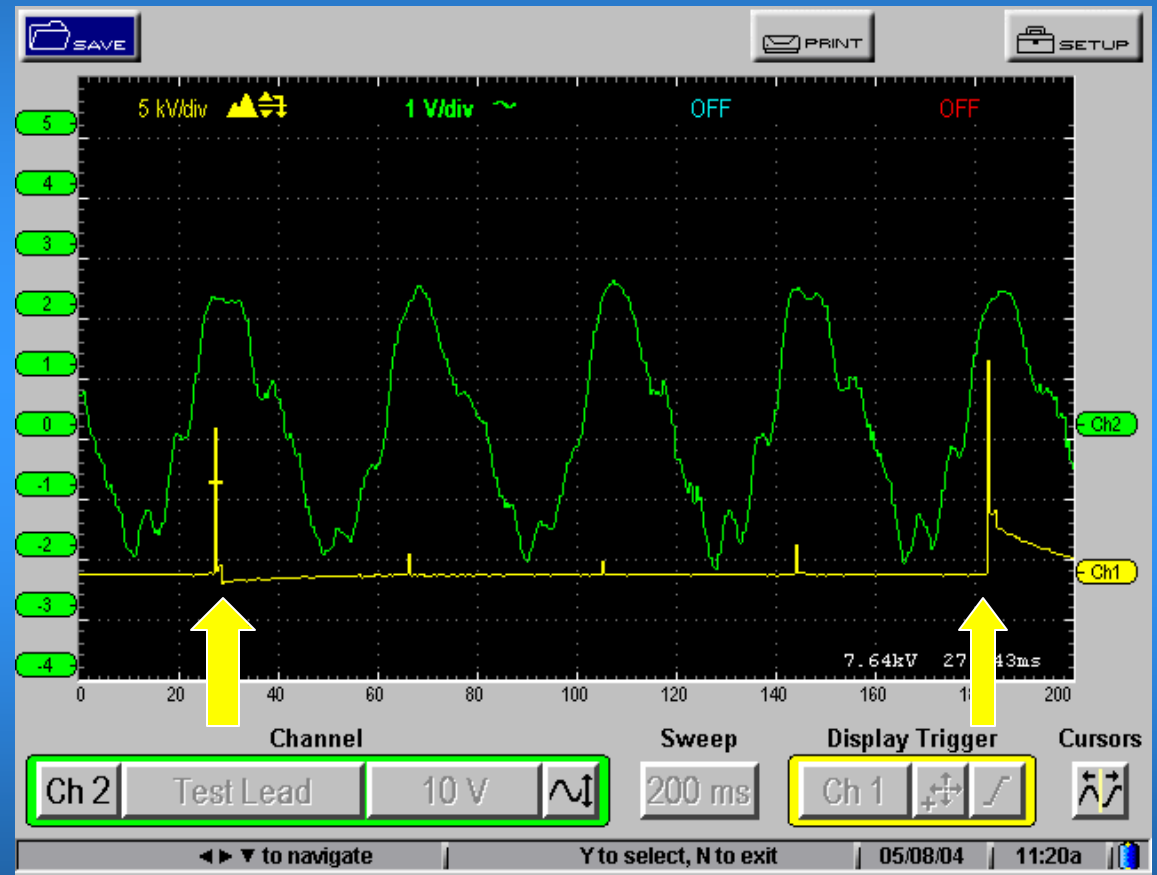
1. Sensor and Tailpipe Tube.
2. Fuel Rail and Vacuum Adaptor.
3. 6 Ft. Banana to BNC cable.
4. 25 Ft. BNC to BNC Cable.
5. BNC to BNC Adaptor.
6. Also included is Timing Chart and copy of Instruction Manual.

# SOME THINGS TO KNOW

- THE MASS THAT LEAVES THE CYLINDER IS WHAT WE ARE LOOKING AT
- THE MORE MASS THE HIGHER THE SIGNAL
- THE LESS MASS THE LOWER THE SIGNAL
- THERE ARE EXCEPTIONS TO THESE RULES WHICH YOU WILL LEARN OVER TIME

# 89 VOLVO DL

- Yellow arrows indicate time between #1 cylinder spark plug triggers.
- You need this milli second reading to know how much of this time to assign to each cylinder
- See following chart

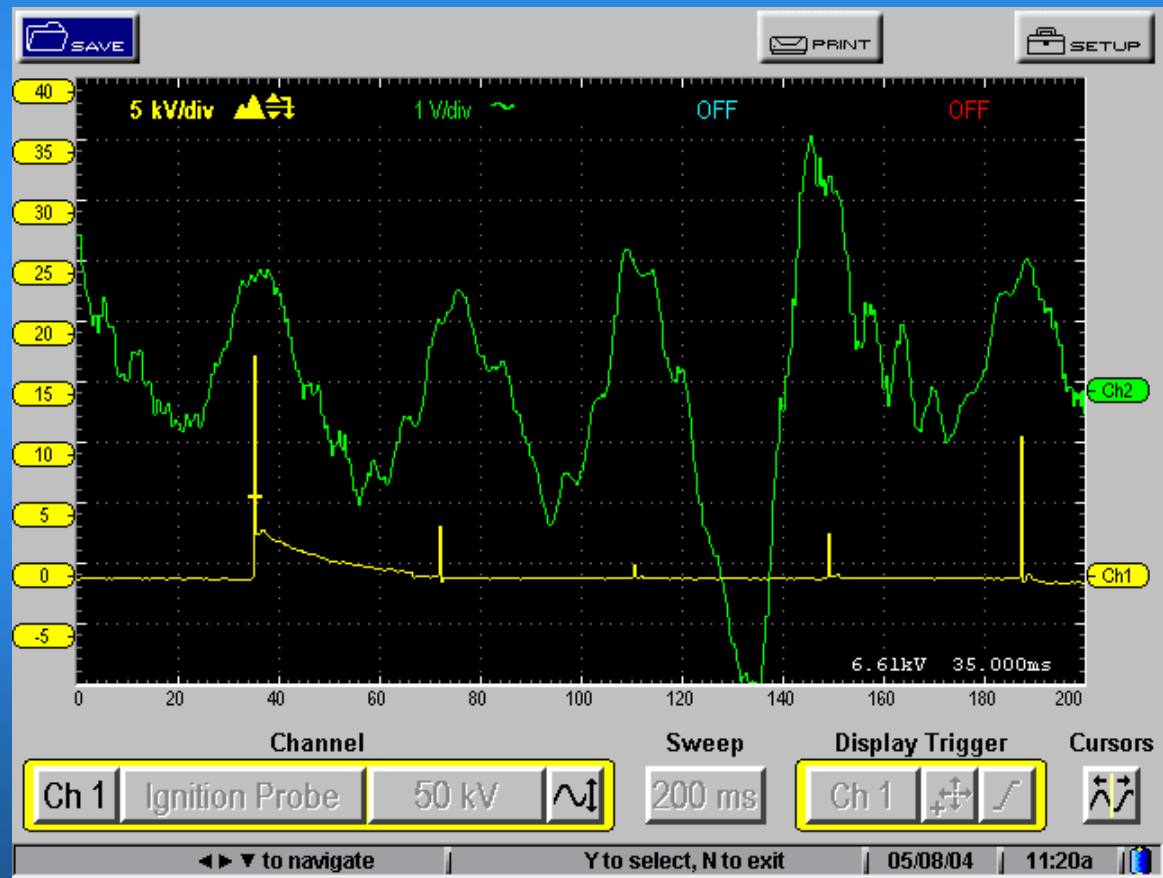


## Automotive Timing chart for 4 cycle engines.

Engine Speed (rpm)	Time Between Valve Opening Events (milliseconds)						Time to Complete 1 Cycle in 4 Stroke Engine (ms)	Starting Time Base Reference (ms)
	2 Cylinder	4 Cylinder	5 Cylinder	6 Cylinder	8 Cylinder	10 Cylinder		
150	400.0	200.0	160.0	133.3	100.0	80.0	800.0	
175	342.9	171.4	137.1	114.3	85.7	68.6	685.7	cold crank
200	300.0	150.0	120.0	100.0	75.0	60.0	600.0	600
225	266.7	133.3	106.7	88.9	66.7	53.3	533.3	
250	240.0	120.0	96.0	80.0	60.0	48.0	480.0	
300	200.0	100.0	80.0	66.7	50.0	40.0	400.0	
350	171.4	85.7	68.6	57.1	42.9	34.3	342.9	
400	150.0	75.0	60.0	50.0	37.5	30.0	300.0	
450	133.3	66.7	53.3	44.4	33.3	26.7	266.7	
500	120.0	60.0	48.0	40.0	30.0	24.0	240.0	
550	109.1	54.5	43.6	36.4	27.3	21.8	218.2	
600	100.0	50.0	40.0	33.3	25.0	20.0	200.0	200
650	92.3	46.2	36.9	30.8	23.1	18.5	184.6	
700	85.7	42.9	34.3	28.6	21.4	17.1	171.4	
750	80.0	40.0	32.0	26.7	20.0	16.0	160.0	IDLE
800	75.0	37.5	30.0	25.0	18.8	15.0	150.0	
850	70.6	35.3	28.2	23.5	17.6	14.1	141.2	
900	66.7	33.3	26.7	22.2	16.7	13.3	133.3	
950	63.2	31.6	25.3	21.1	15.8	12.6	126.3	
1000	60.0	30.0	24.0	20.0	15.0	12.0	120.0	
1100	54.5	27.3	21.8	18.2	13.6	10.9	109.1	low rpm
1200	50.0	25.0	20.0	16.7	12.5	10.0	100.0	100
1300	46.2	23.1	18.5	15.4	11.5	9.2	92.3	
1400	42.9	21.4	17.1	14.3	10.7	8.6	85.7	
1500	40.0	20.0	16.0	13.3	10.0	8.0	80.0	POWER TEST

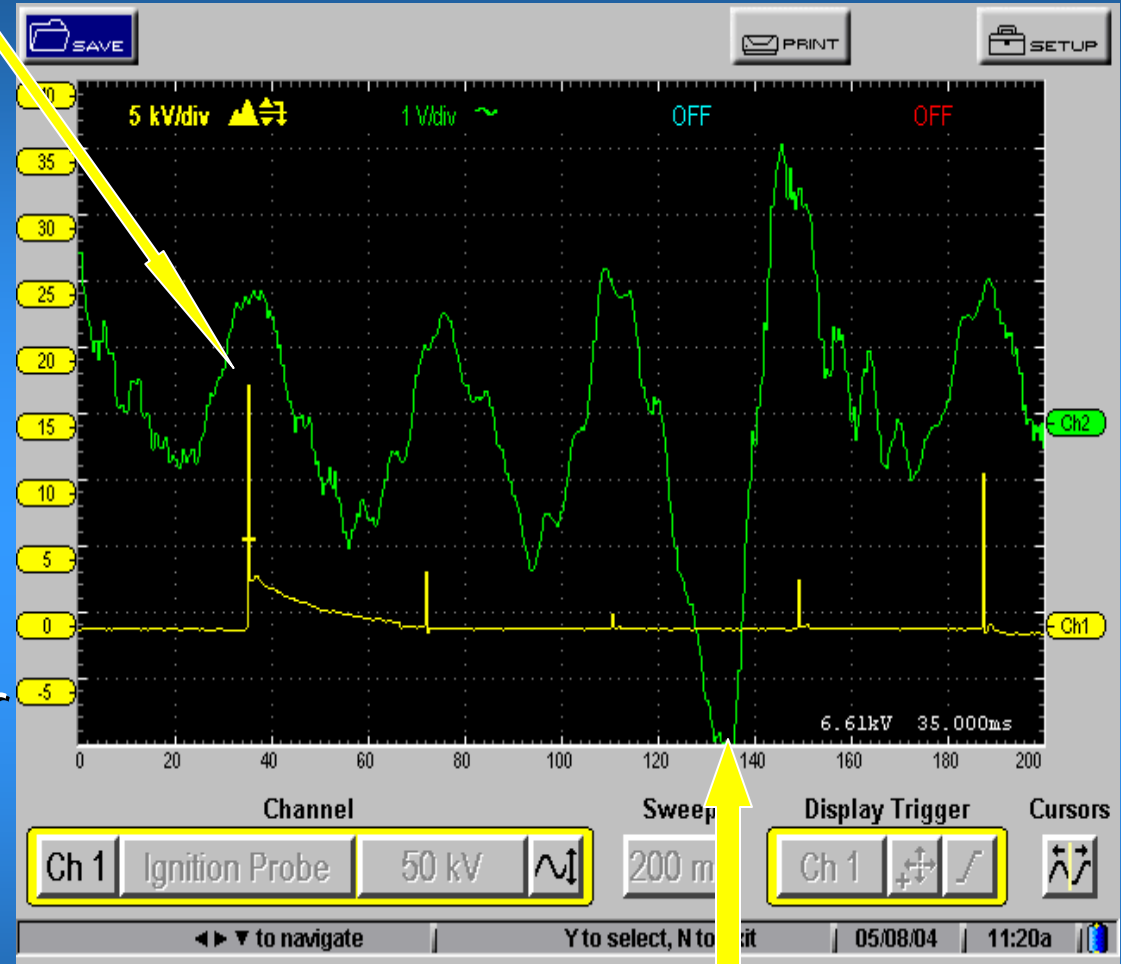
# How do you find the #1 cylinder?

- Tail pipe readings are offset from the trigger reference. This accounts for time from ignition firing to exhaust valve opening.
- You need to understand offset to properly locate problem cylinder.





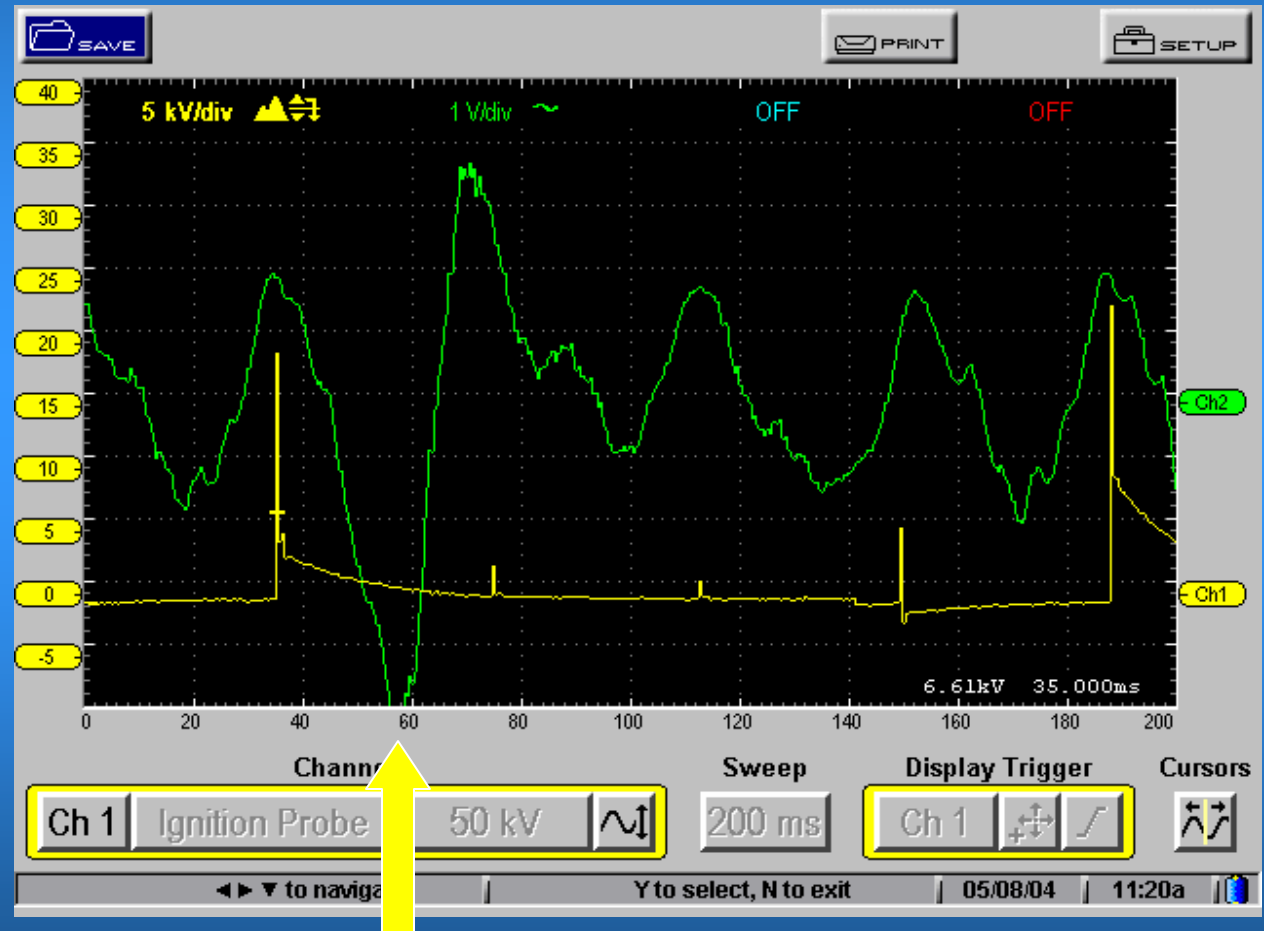
- From the **start** of your trigger point, offset the cylinder like this
- 4 cylinder one cylinder
- 6 cylinder two cylinder
- 8 cylinder three cylinder
- This Volvo fire order is 1-3-4-2
- But with the offset it is read on the scope as
- 2-1-3-4



In this example #3 is the problem  
It has an open wire

# SAME VOLVO BUT PROBLEM CYLINDER HAS CHANGED

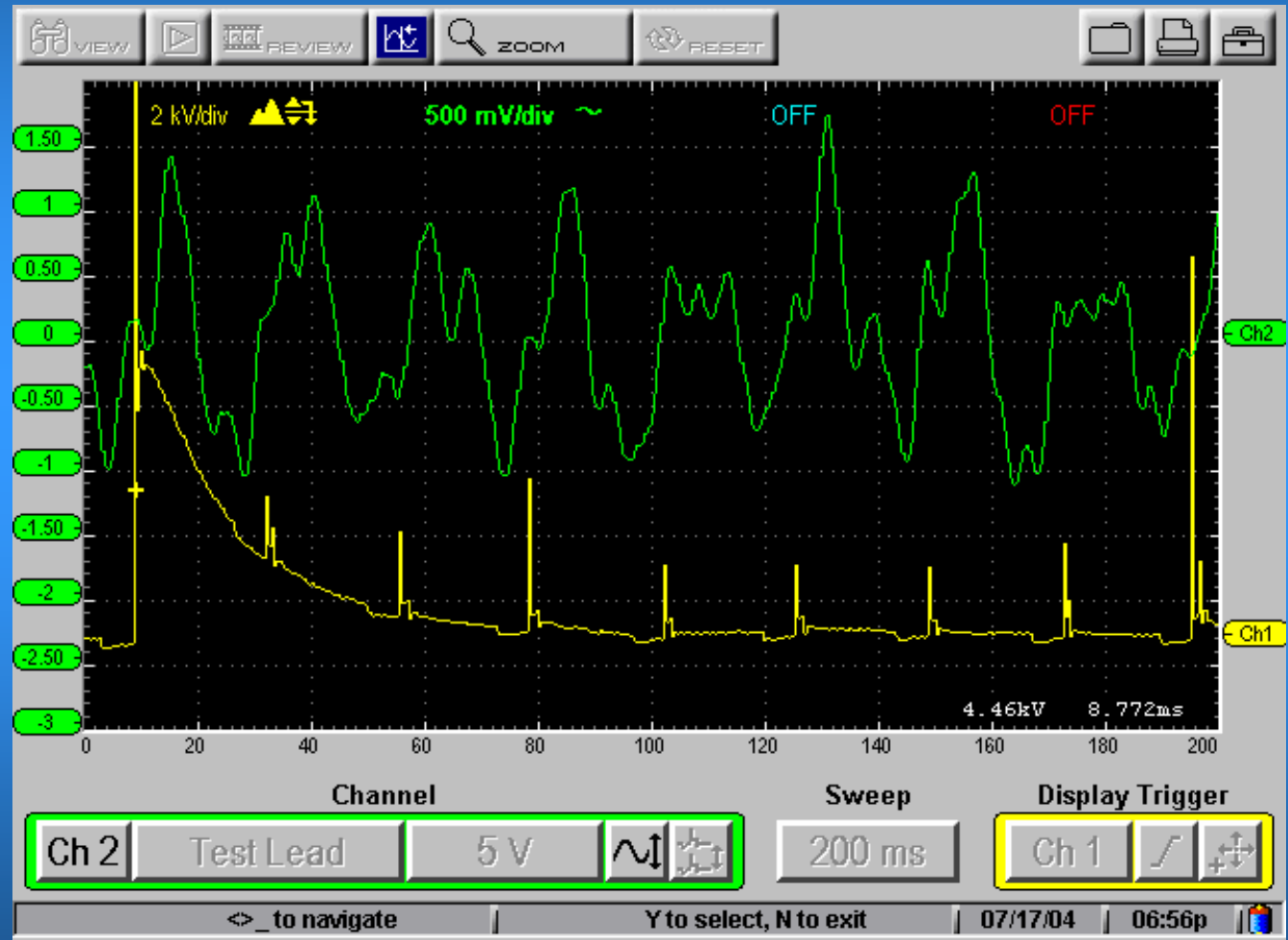
- Which cylinder do you think it is?
- Remember the offset 1-3-4-2 reads like.
- 2-1-3-4



Number 2 cylinder is correct

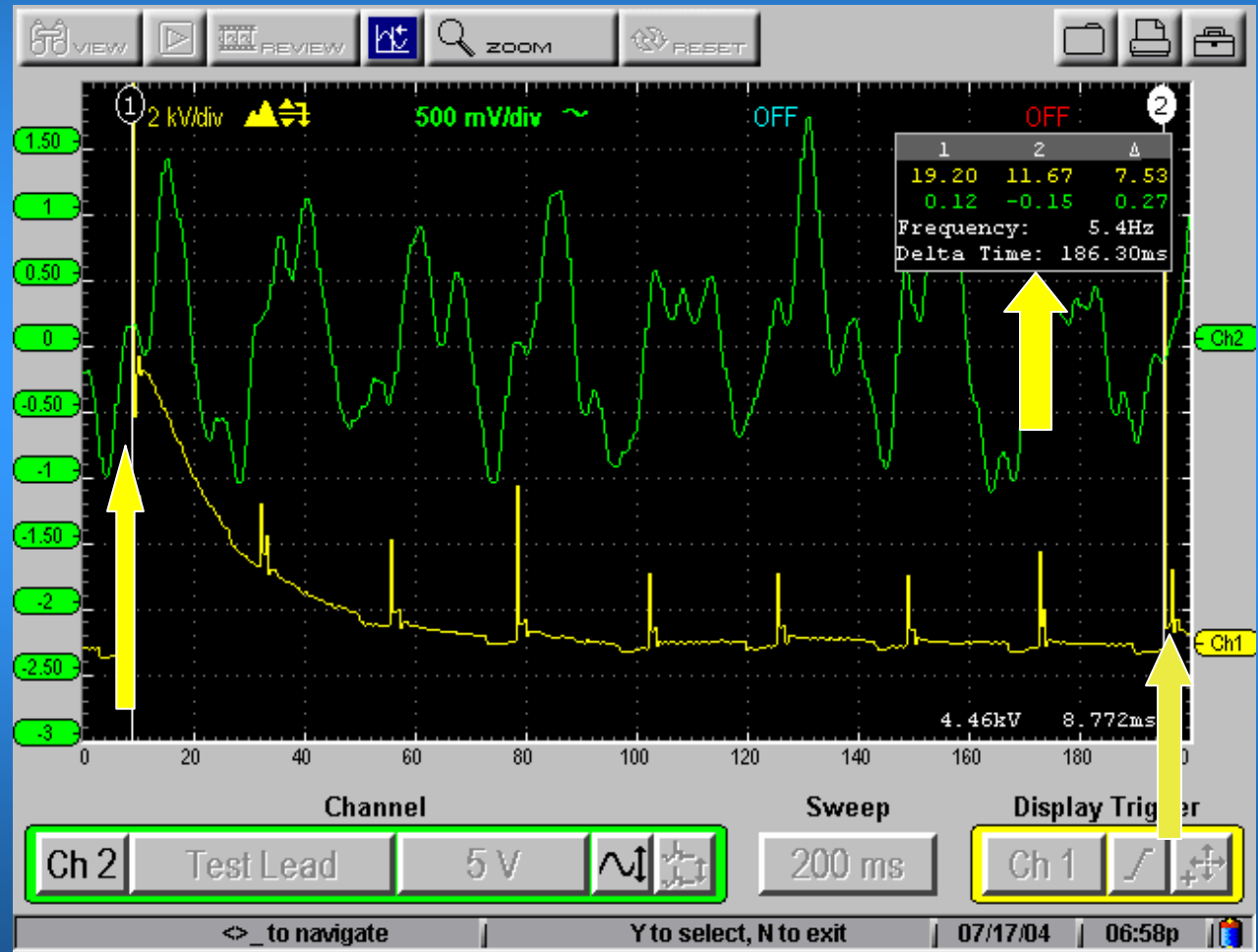
# 93 JEEP GRAND CHEROKEE 5.2

- How to use the time chart



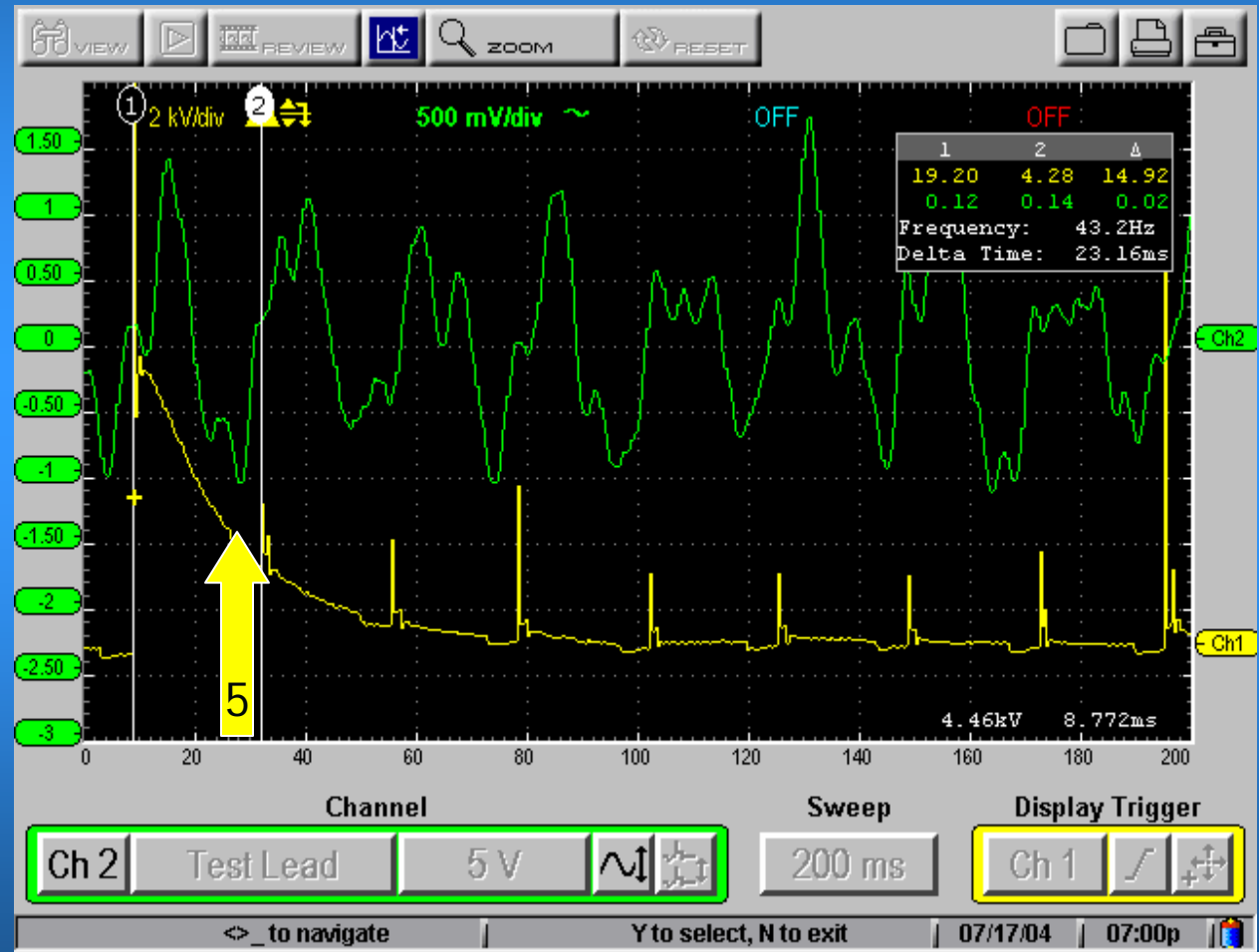
# 93 JEEP GRAND CHEROKEE 5.2

- The time between #1 cylinder ignition triggers is 186.30ms
- Using the chart you see that you assign each cylinder 23.1 ms



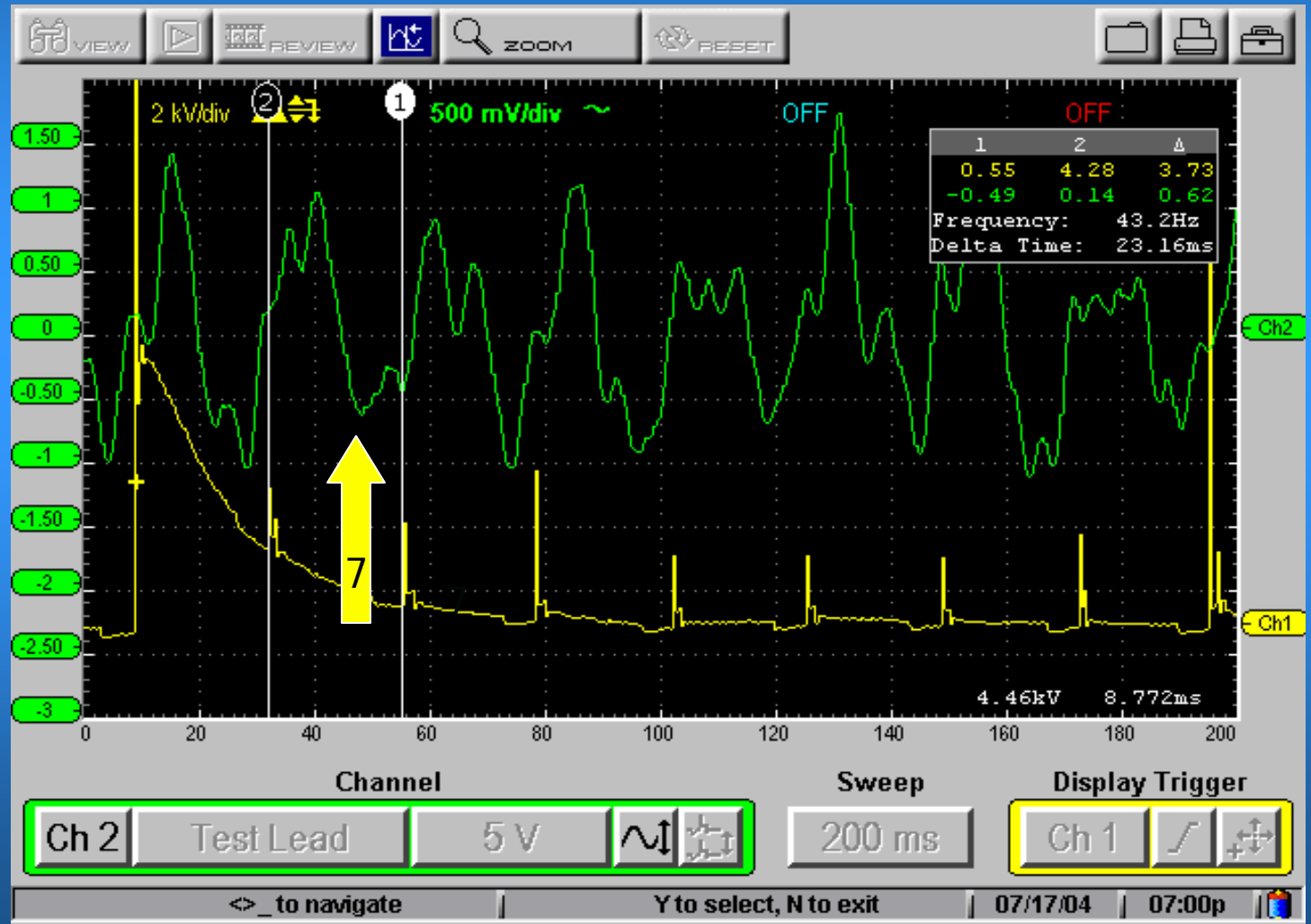
# 93 JEEP GRAND CHEROKEE 5.2

- FIRE ORDER IS 1-8-4-3-6-5-7-2 WHICH READS LIKE
- 5-7-2-1-8-4-3-6
- USE THE CURSORS TO SEE EACH CYLINDER



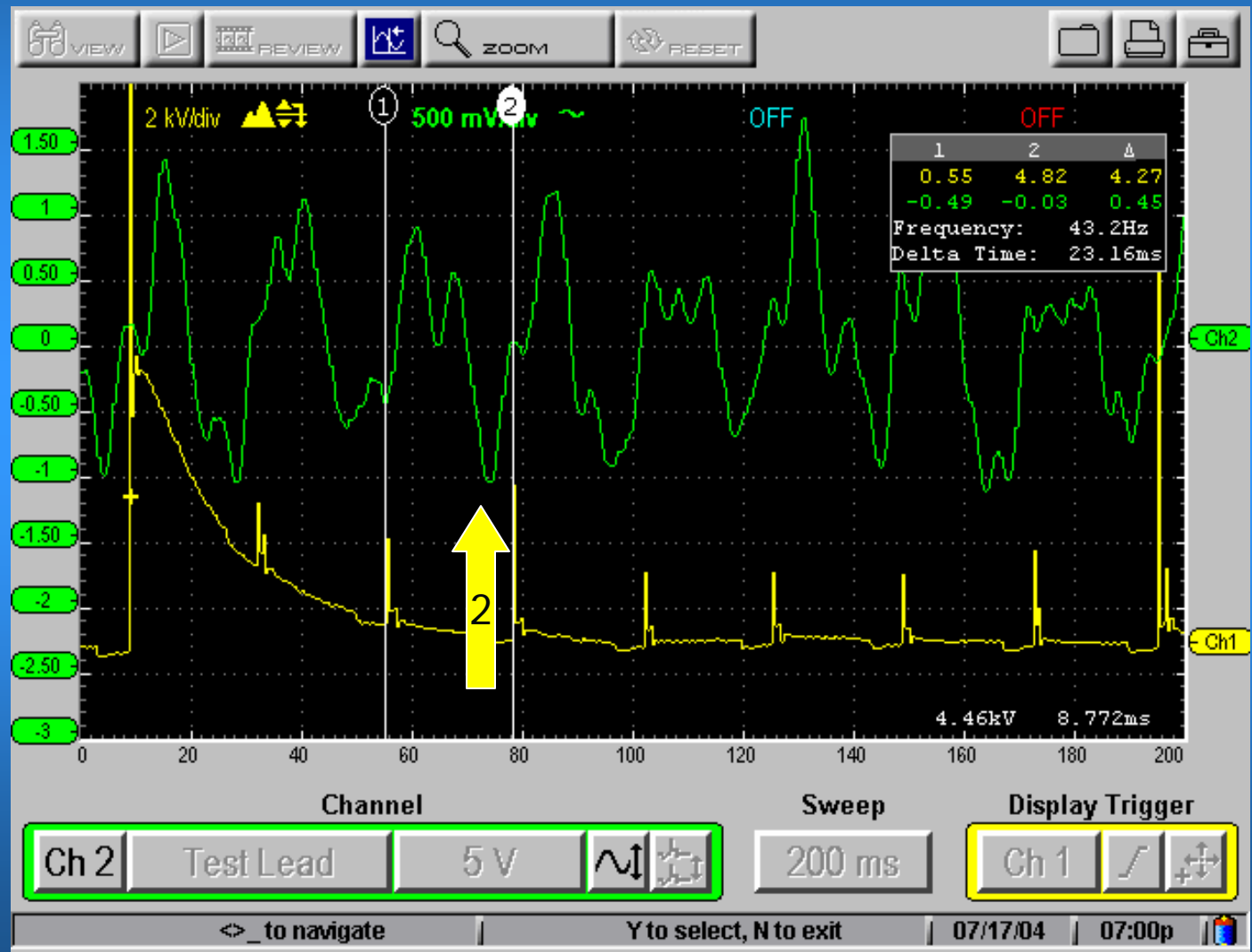
# 93 JEEP GRAND CHEROKEE 5.2

- Go right down the line



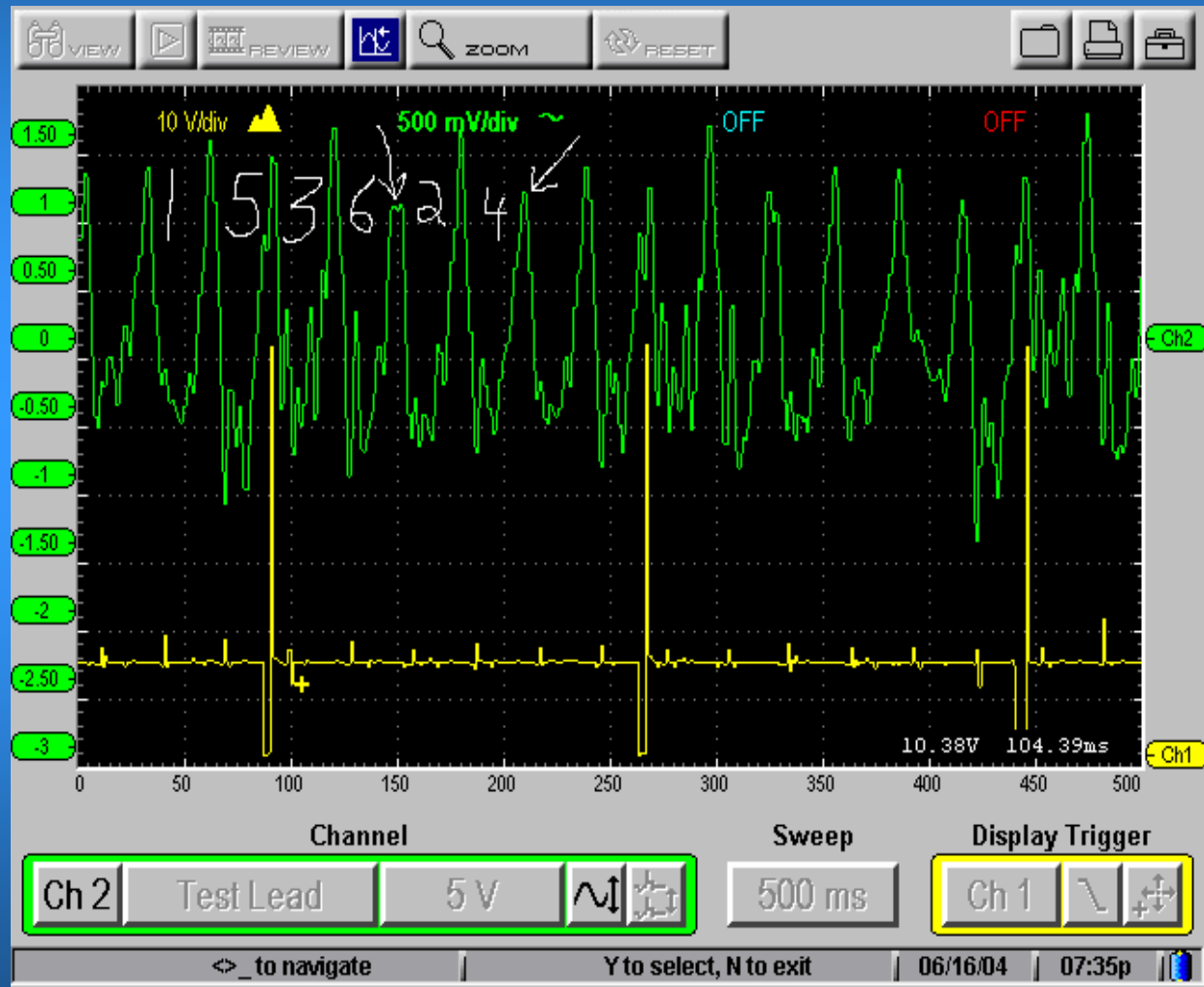
# 93 JEEP GRAND CHEROKEE 5.2

- Remember the **offset** for eight cylinders is the last three cylinders get read first



# 2000 JEEP CHEROKEE LEAN INJECTOR

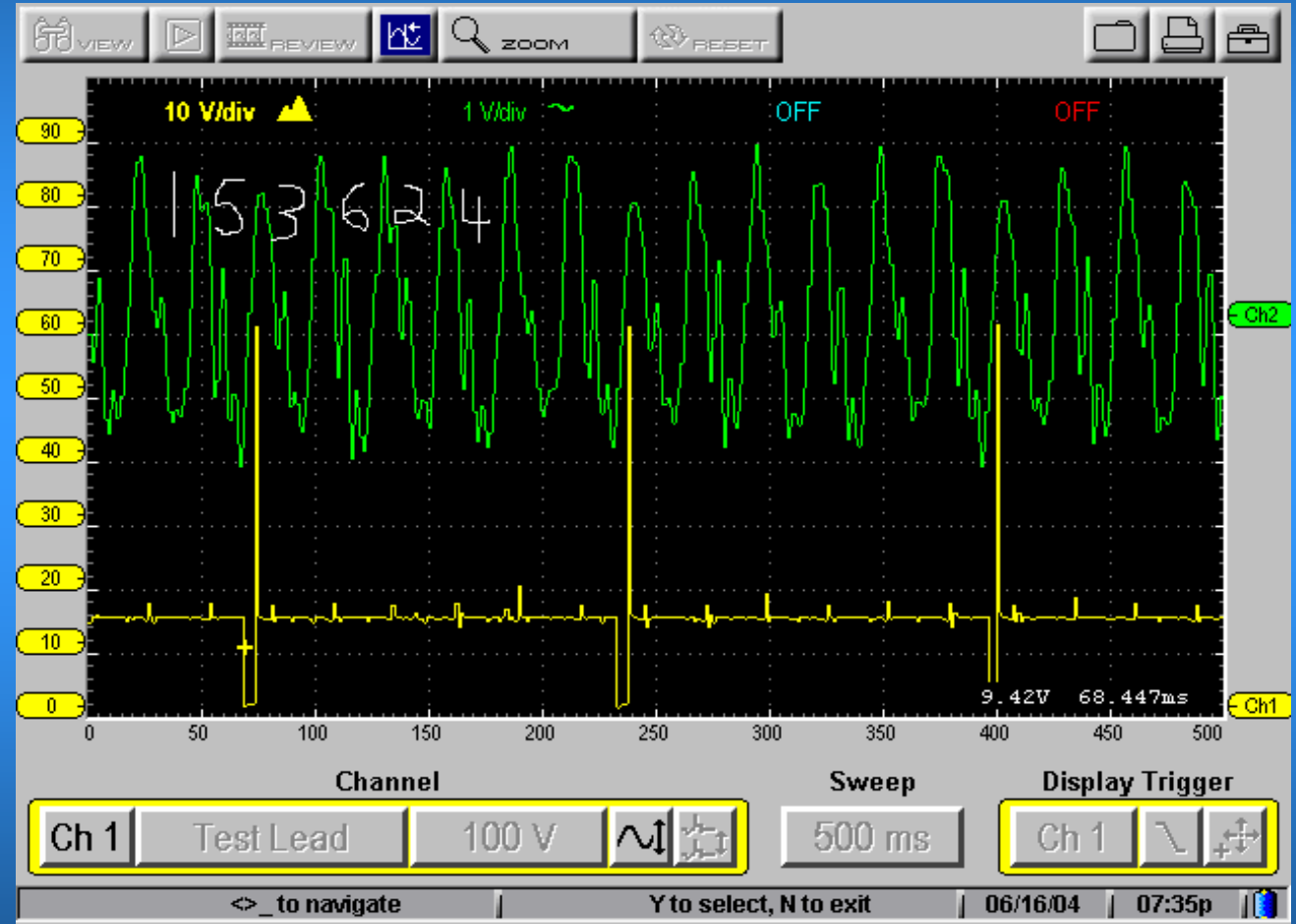
- This one is triggered off #1 injector so the first cylinder starts at 30 ms to the left of the trigger point.
- You can see less mass is leaving two of the cylinders.





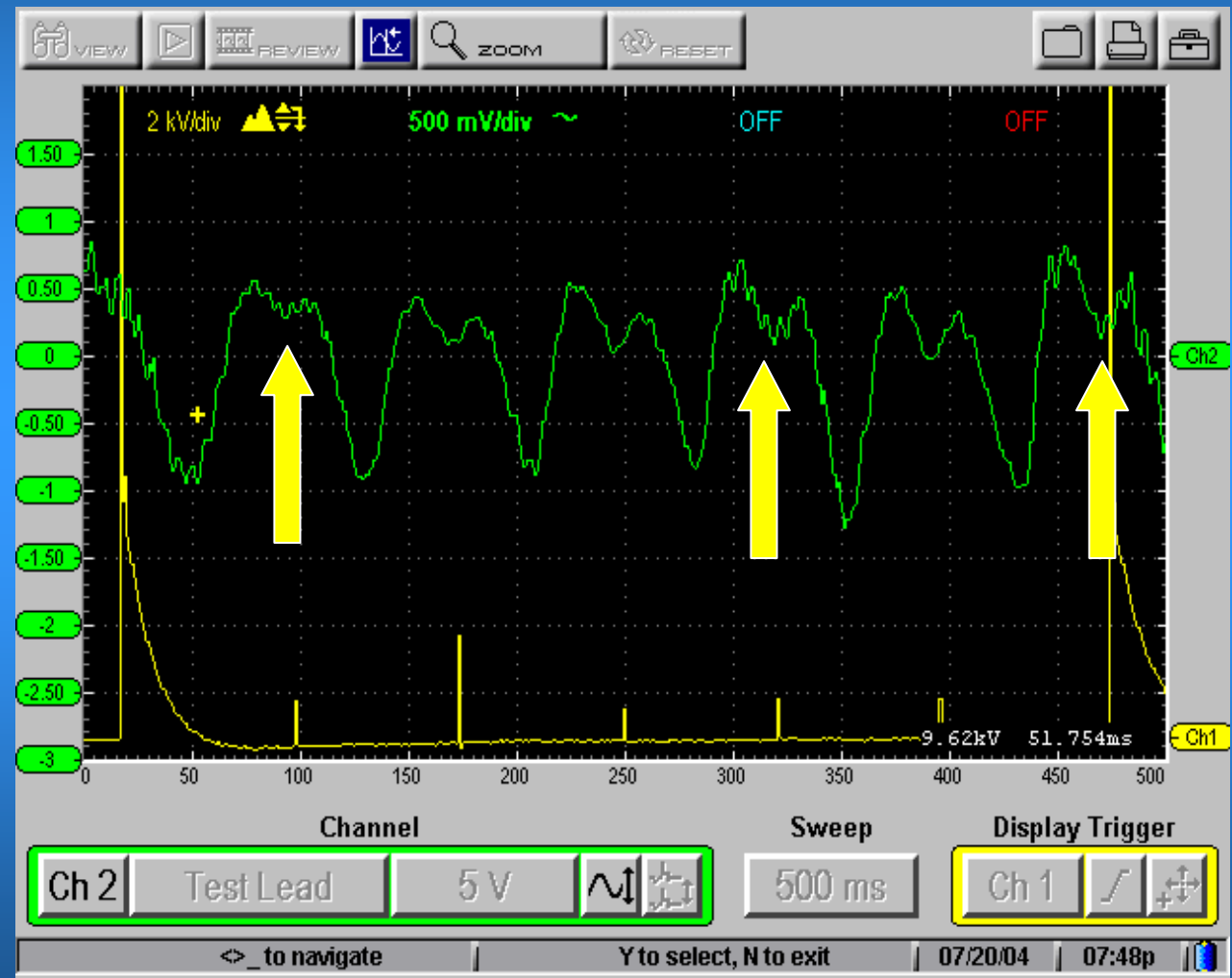
# 2000 JEEP CHEROKEE INJECTORS

- AFTER # 4 AND 6 INJECTORS WERE REPLACED
- REMEMBER THE ONLY SYMPTOM WAS A ROUGH IDLE AND A P306 CODE
- THIS INFO MADE A FAST AND SIMPLE FIX TO A PROBLEM THAT IS HARD TO PINPOINT



# 89 SABLE 3.8 CRANK TEST

- Disable fuel pump, crank engine
- This test checks engine valve train function
- You can see the valves working.
- Or not, see arrows!!!!



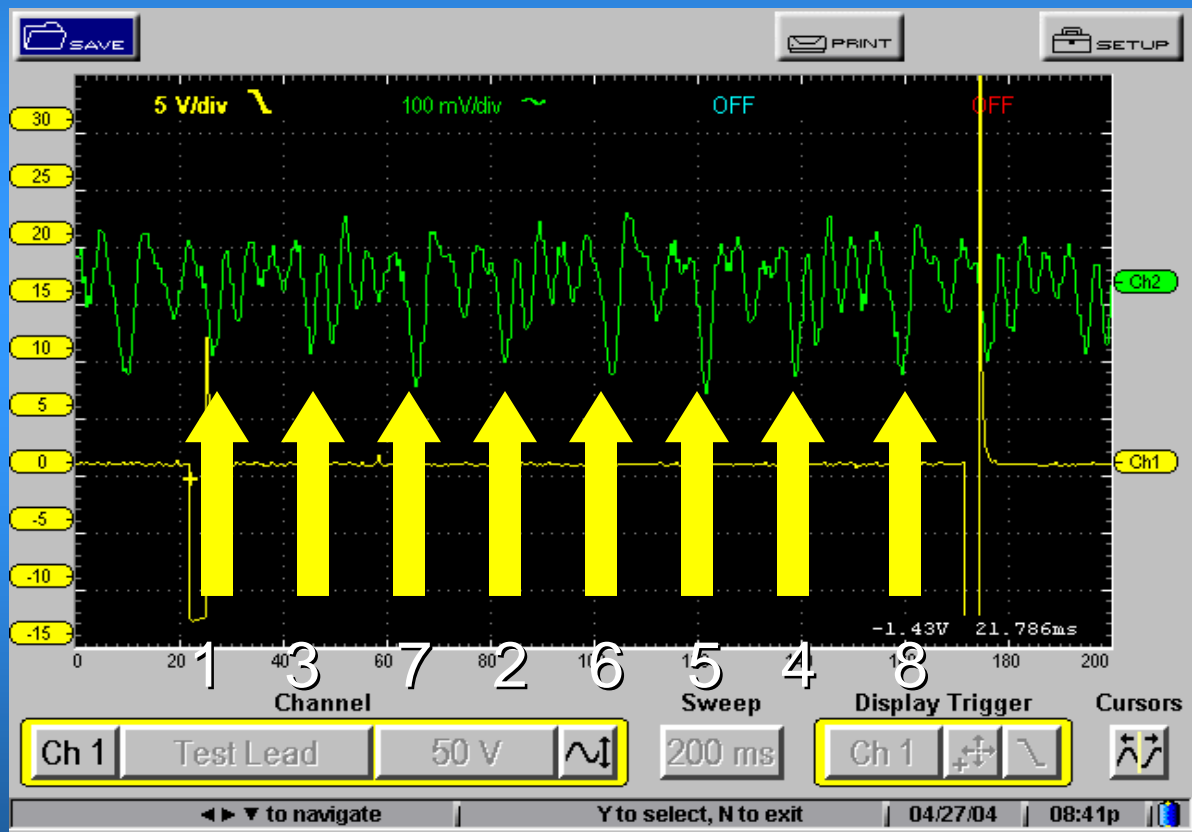
# 95 INTREPID 3.5

- Triggered off the fuel pressure regulator you can see the actual injector drop of each injector
- This car has a different view on each fuel rail



# TOWN CAR INJECTOR RAIL TEST

- Actually see the volume difference between the injectors
- Just disconnect the fuel pressure regulator hose and plug it. Next connect the impulse sensor to the fuel pressure regulator
- You are now reading the pulses created by the diaphragm as the injectors open and close.
- The less volume not as much of a drop, the more volume the deeper the drop off



# Basic Theory

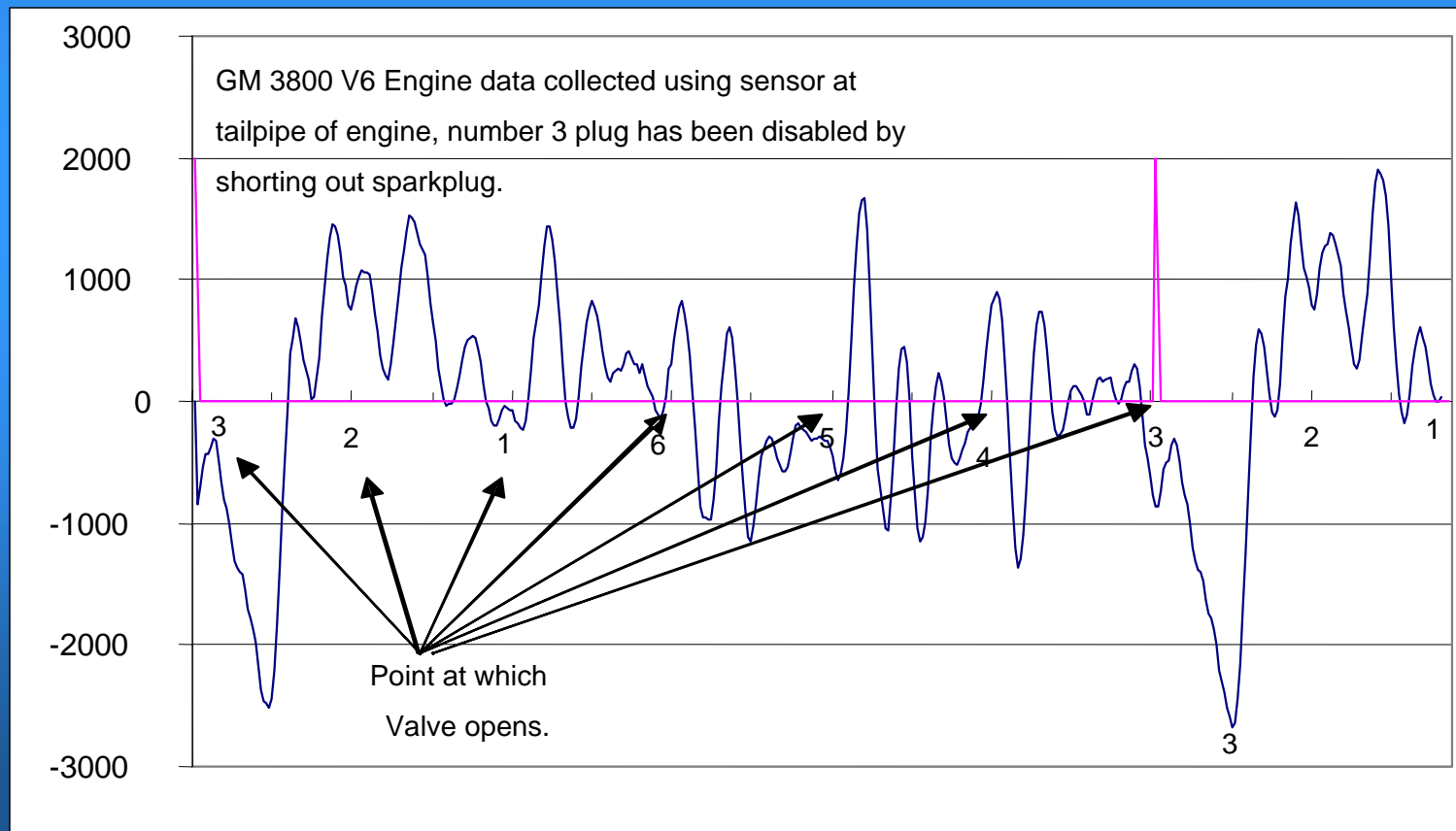
- It is important to note that changes in timing advance, pipe length and effects of tuned exhaust will have an impact on waveform outputs. Some waveforms will be almost perfect but others will show the effect of a tuned exhaust system. Engine problems will always cause a fluctuation of the waveform that extends above or below the average of the other cylinders. This is where comparative analysis of cylinders becomes important. In general the more symmetrical the waveform and distribution above and below the zero reference line, the better the condition of the engine. (Reference Figure 14)

# Basic Theory

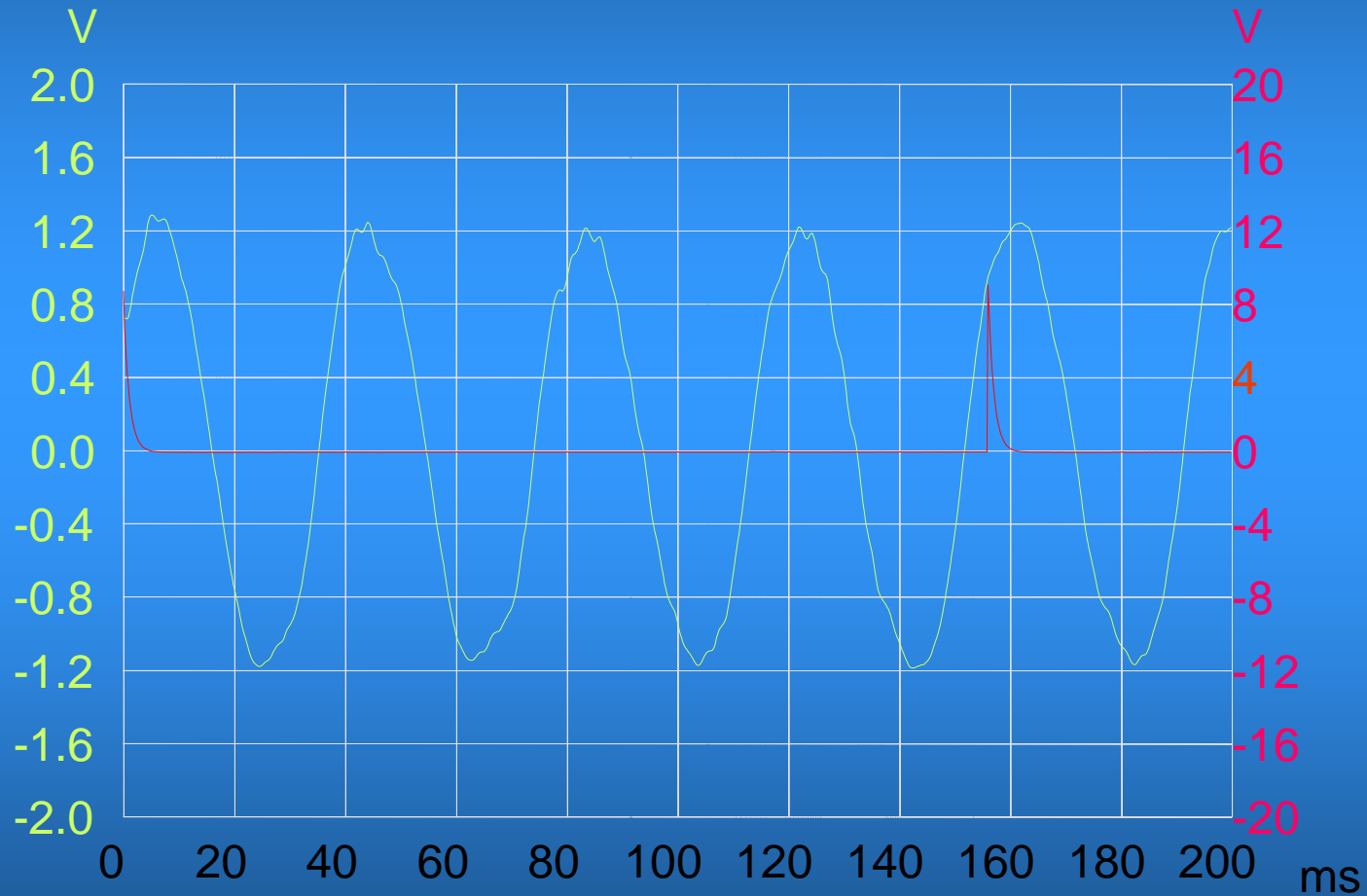
- Conditions caused by lack of fuel or lean burn will cause a drop-out in the waveform. Problems resulting in excess fuel (dirty injectors, poor combustion, dirty plugs, plug wire problems) will show up as a drop-out in the waveform followed by an increase in waveform above zero as the engine works to compensate for the excess fuel as it is burned in the manifold (reference figure 14). This is the work of the computer and oxygen sensor in today's engines.

# Figure 14

- Engine firing order is 1,6,5,4,3,2 and the trigger is on cylinder #1; the scope pattern as seen through the exhaust is read as 3,2,1,6,5,4 after taking into account the required cylinder offset.



**Four cylinder Honda. Firing order is 1-4-3-2; Order of display is 2-1-4-3.**



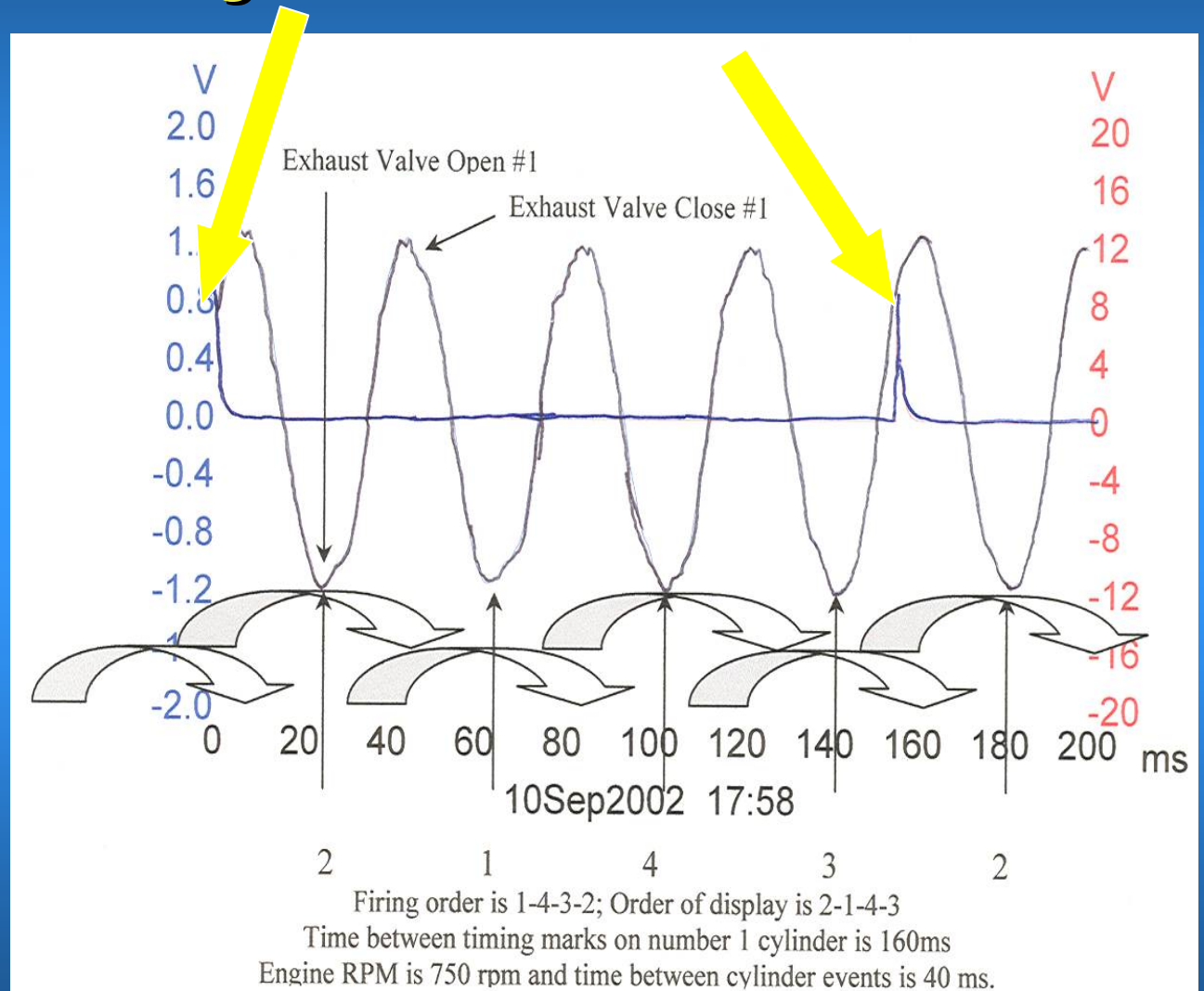
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# Let's make sense of what we see. Same 4 cylinder Honda.

## Number one trigger events

- Use the chart to time it out
- There is 160 ms between # 1 triggering events.
- That means on a four cylinder engine the rpm is 750.
- Which means 40 ms per cylinder.
- On the cycle arrows the lightly shaded half are the combustion cycles and the unshaded half are the exhaust cycles.



# QUICK SCOPE SET UP GUIDE TO IGNITION TRIGGER SET UP

- You will need a dual trace scope.
- Place FirstLook pulse sensor in tail pipe at least 4 inches.
- Trigger the scope on either trace A or B to # 1 ignition wire.
- Use the other trace for the pulse sensor.
- Remember to set trace to AC volts and volts scale will vary depending on RPM of engine. Try 1v or 2v for a cold cranking test.
- For an idle test, try 5v OR 10v scale.
- Same higher voltage for a 1500 RPM or 2500 RPM load test.

## ■ TIME GUIDE

- Set time to 600ms or 1 sec for a cranking test to view all cylinders.
- Set time to 200ms or scope screen to view all cylinder at idle.
- Set time to 100ms or 50ms for a loaded or higher RPM.
- Using the offset, the cylinder will appear in the order just to the right of the trigger point on the ignition trace.
- Place FirstLook Pulse sensor in the tailpipe at least 4 inchs.
- Trigger the scope on either trace A or B to #1 ignition wire.
- Use the other trace for the FirstLook Pulse sensor.
- Remember to set trace to AC volts and volts scale will vary depending on RPM of engine. Try 1v or 2v for cold cranking test.
- For an idle test, try 5v or 10v scale.
- Same higher voltage for 1500 RPM or 2500 RPM load test

# QUICK GUIDE TO INJECTOR TRIGGER SETUP

- Use either trace A or B to #1 injector control signal, use this trace for your trigger.
- Place FirstLook sensor probe at least 4 inches into tail pipe.
- Connect the other trace to pulse sensor.
- Use same time and voltage scale as mentioned earlier.
- Now the only difference will be that the that the number one cylinder will appear 20-30ms to the left of the trigger point.
- The Jeep Cherokee example in this manual demonstrates this.

# Quick Guide To Vacuum Tests

- Use the same scope guide lines as mentioned earlier.
- Hook up the FirstLook sensor to a vacuum line common to all cylinders, such as the brake booster, if possible.
- Now the cylinders in the offset will be in the fire order just to the right of the trigger point.
- This is a good way to see the intake valves.

# Injector Rail Test

- This is one of the fastest ways to see if there is a volume difference between any of the injectors.
- Just remove the vacuum line from the fuel pressure regulator and plug it. Now hook up the impulse sensor to the fuel pressure regulator nipple.
- Trigger the scope on either #1 injector or #1 ignition wire. There is no off set to think about here. They will show up in the correct fire order.
- Set the trace up with the pulse sensor to either 1v or 2v ac scale, time is consistent with all other tests.
- As the injector pintles open and close, the sensor reads the pressure drop that the fuel pressure regulator diaphragm creates.
- All that is left is to see is which injector amplitude is higher (more fuel) or lower (less fuel).
- As with all of the tests mentioned it is very important to practice on known good cars and create certain conditions to see how they compare.

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# Acknowledgements

- Special thanks to Jeff Kogan who has developed much of the basic text and waveforms.

Square One Diagnostics  
Email (square1d@optonline.net)

- Graphics and Editing Jim Marinik.

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