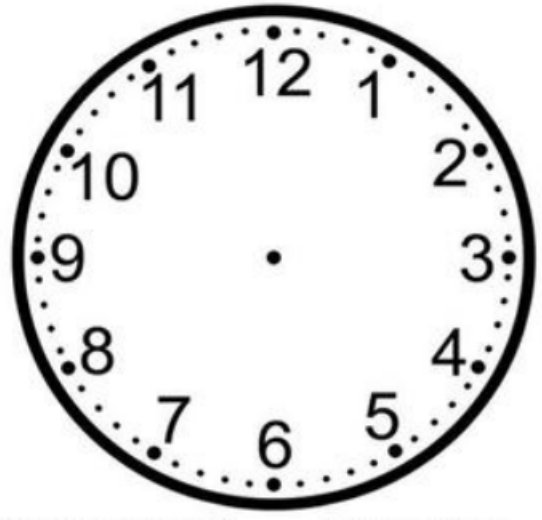
Why is a minute divided into 60 seconds, an hour into 60 minutes, yet there are only 24 hours in a day?

Why is a second broken down into thousands of a second or milliseconds (ms) ?

Regardless, we need to understand time division in relation to an oscilloscopes sweep times.



One Hour = 60 Minutes
One Minute = 60 seconds

Common Factor of 60, Right

Not So Quick

One Second (s) = 1000 milliseconds (ms)

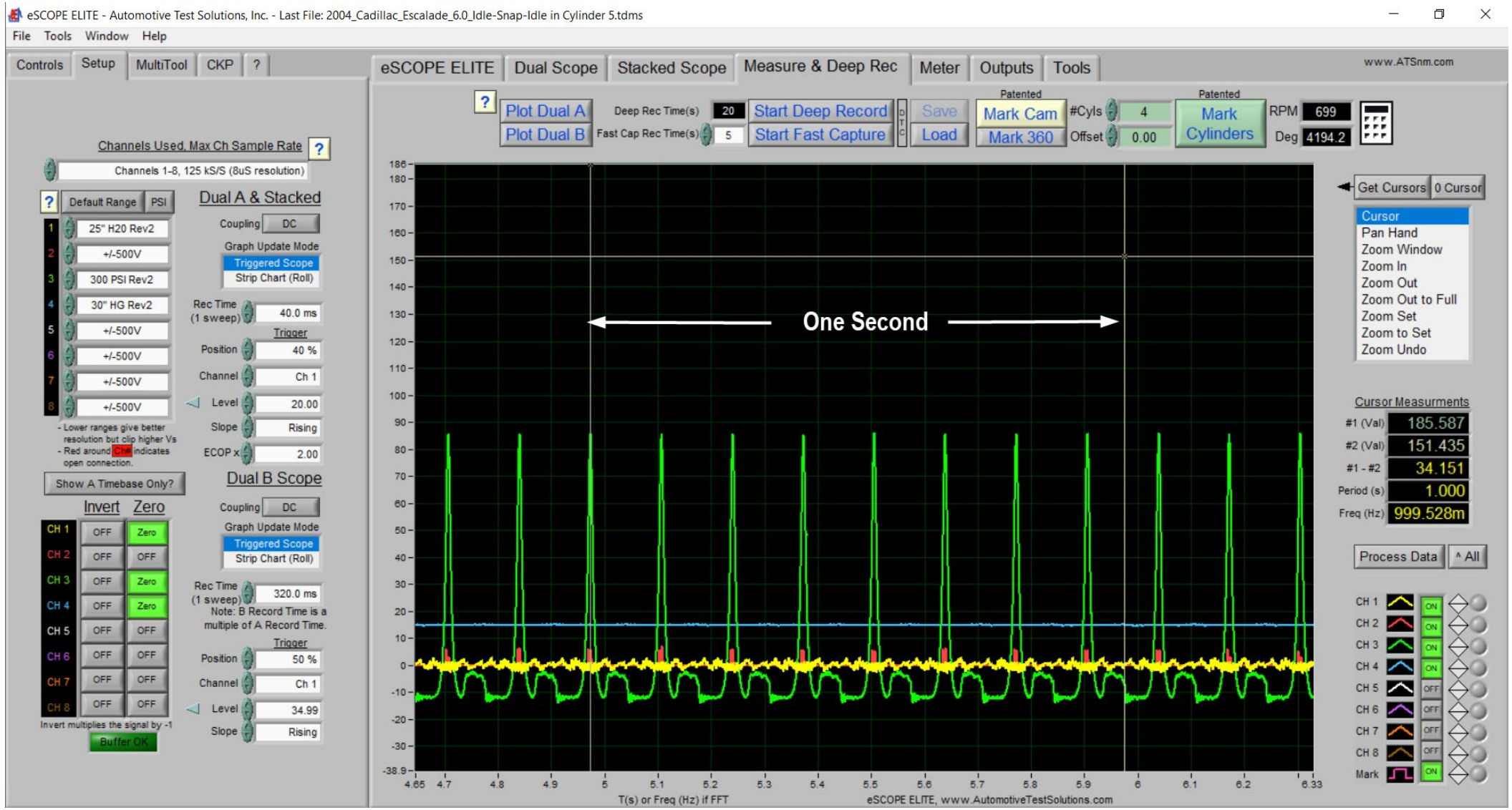
µs
A microsecond is a unit of time in the International System of Units (SI) equal to one millionth (0.000001 or 10^{-6} or 1⁄1,000,000) of a second. Its symbol is µs, sometimes simplified to us when Unicode is not available.

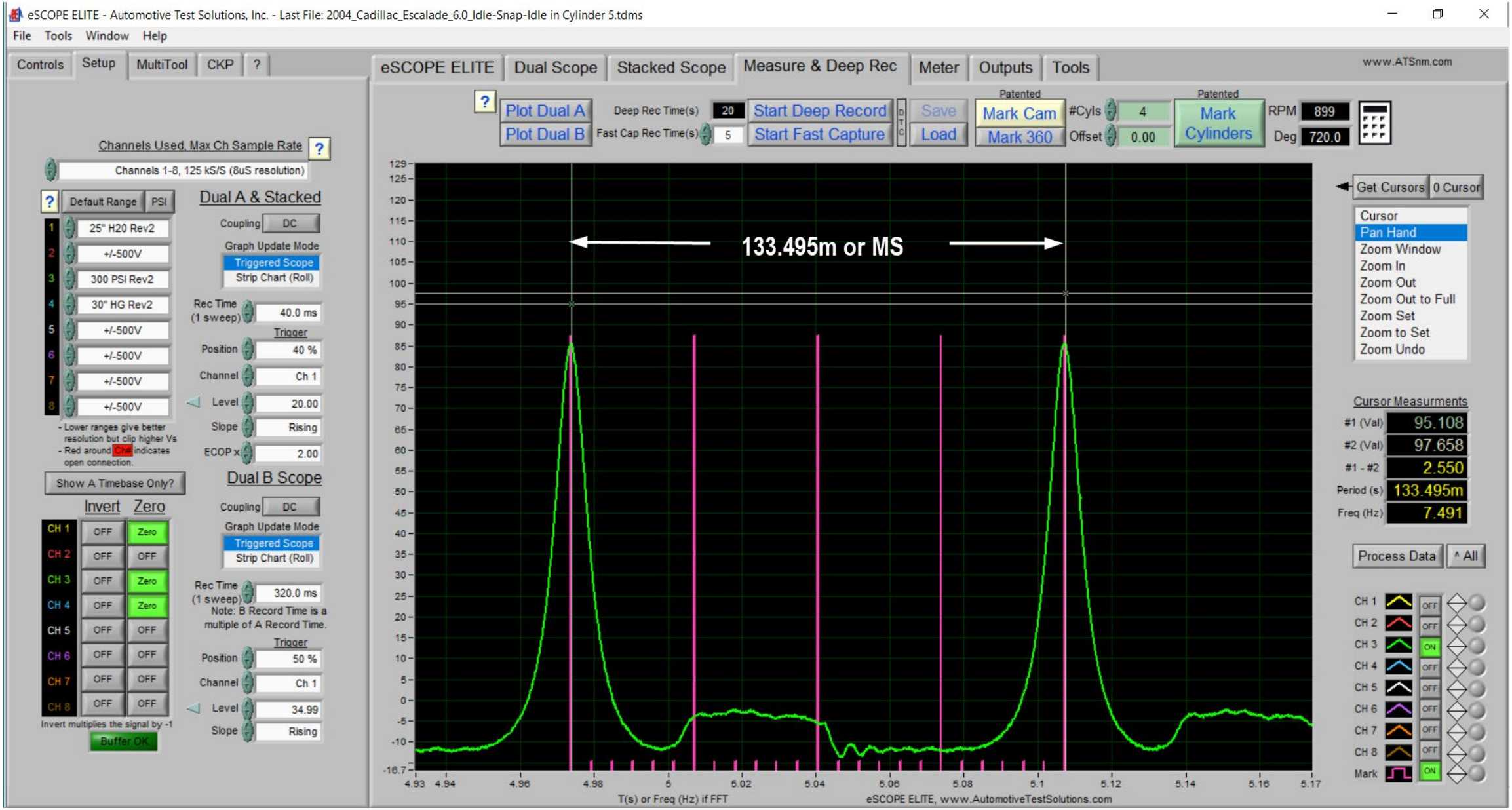
A **picosecond** (abbreviated as **ps**) is a unit of time in the International System of Units (SI) equal to 10^{-12} or $1/1\,000\,000\,000\,000$ (one trillionth) of a second.

Understanding eSCOPE ELITE Sweep Time

Examples used in this presentation

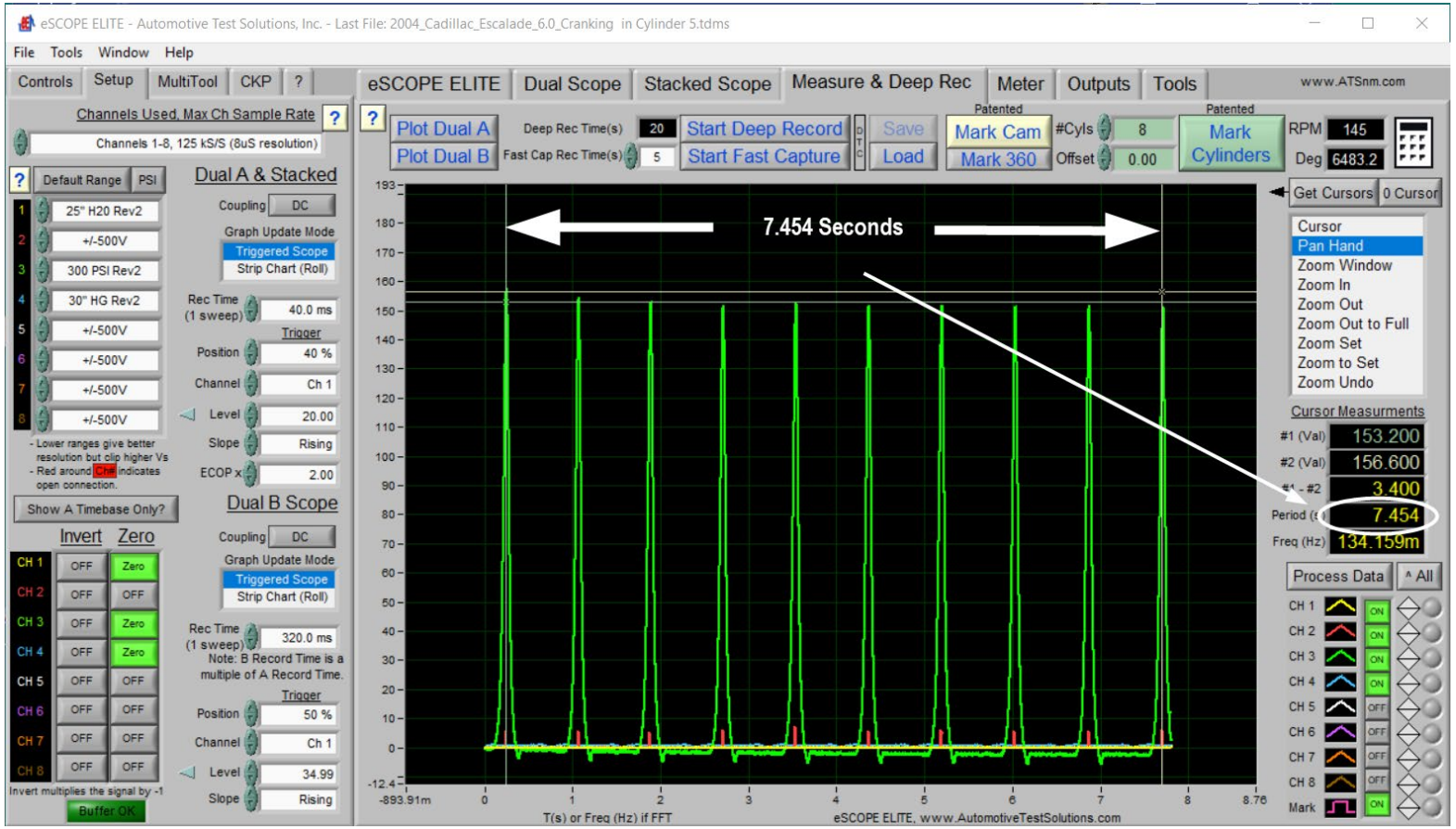
1. Cranking Engine
2. Idle-Snap-Idle
3. Cam – Crank Correlation
4. Fuel Injector
5. Ignition Coil


eSCOPE ELITE - Automotive Test Solutions, Inc. - Last File: 2004_Cadillac_Escalade_6.0_Idle-Snap-Idle in Cylinder 5.tdms
File Tools Window Help
Controls Setup MultiTool CKP ?
eSCOPE ELITE Dual Scope Stacked Scope Measure & Deep Rec Meter Outputs Tools
www.ATSnm.com
Channels Used, Max Ch Sample Rate
Channels 1-8, 125 kS/S (8uS resolution)
Default Range PSI
25" H20 Rev2
+/-500V
300 PSI Rev2
30" HG Rev2
+/-500V
+/-500V
+/-500V
+/-500V
- Lower ranges give better resolution but clip higher Vs
- Red around Ch# indicates open connection.
Show A Timebase Only?
Invert Zero
Invert multiplies the signal by -1
Buffer OK
Dual A & Stacked
Coupling DC
Graph Update Mode
Triggered Scope
Strip Chart (Roll)
Rec Time (1 sweep) 40.0 ms
Trigger
Position 40 %
Channel Ch 1
Level 20.00
Slope Rising
ECOP x 2.00
Dual B Scope
Coupling DC
Graph Update Mode
Triggered Scope
Strip Chart (Roll)
Rec Time (1 sweep) 320.0 ms
Note: B Record Time is a multiple of A Record Time.
Trigger
Position 50 %
Channel Ch 1
Level 34.99
Slope Rising
Plot Dual A
Plot Dual B
Deep Rec Time(s) 20
Fast Cap Rec Time(s) 5
Start Deep Record
Start Fast Capture
Save
Load
Patented
Mark Cam
Mark 360
#Cyls 4
Offset 0.00
Patented
Mark Cylinders
RPM 699
Deg 4194.2
One Second
Get Cursors 0 Cursor
Cursor
Pan Hand
Zoom Window
Zoom In
Zoom Out
Zoom Out to Full
Zoom Set
Zoom to Set
Zoom Undo
Cursor Measurments
#1 (Val) 185.587
#2 (Val) 151.435
#1 - #2 34.151
Period (s) 1.000
Freq (Hz) 999.528m
Process Data ^ All
T(s) or Freq (Hz) if FFT
eSCOPE ELITE, www.AutomotiveTestSolutions.com


eSCOPE ELITE - Automotive Test Solutions, Inc. - Last File: 2004_Cadillac_Escalade_6.0_Idle-Snap-Idle in Cylinder 5.tdms
File Tools Window Help
Controls Setup MultiTool CKP ?
eSCOPE ELITE Dual Scope Stacked Scope Measure & Deep Rec Meter Outputs Tools
www.ATSnm.com
Plot Dual A
Plot Dual B
Deep Rec Time(s) 20
Fast Cap Rec Time(s) 5
Start Deep Record
Start Fast Capture
Save
Load
Patented
Mark Cam
Mark 360
#Cyls 4
Offset 0.00
Patented
Mark Cylinders
RPM 899
Deg 720.0
Channels Used, Max Ch Sample Rate
Channels 1-8, 125 kS/S (8uS resolution)
Default Range PSI
1 25" H20 Rev2
2 +/-500V
3 300 PSI Rev2
4 30" HG Rev2
5 +/-500V
6 +/-500V
7 +/-500V
8 +/-500V
- Lower ranges give better resolution but clip higher Vs
- Red around Ch# indicates open connection.
Show A Timebase Only?
Invert Zero
CH 1 OFF Zero
CH 2 OFF OFF
CH 3 OFF Zero
CH 4 OFF Zero
CH 5 OFF OFF
CH 6 OFF OFF
CH 7 OFF OFF
CH 8 OFF OFF
Invert multiplies the signal by -1
Buffer OK
Dual A & Stacked
Coupling DC
Graph Update Mode
Triggered Scope
Strip Chart (Roll)
Rec Time (1 sweep) 40.0 ms
Trigger
Position 40 %
Channel Ch 1
Level 20.00
Slope Rising
ECOP x 2.00
Dual B Scope
Coupling DC
Graph Update Mode
Triggered Scope
Strip Chart (Roll)
Rec Time (1 sweep) 320.0 ms
Note: B Record Time is a multiple of A Record Time.
Trigger
Position 50 %
Channel Ch 1
Level 34.99
Slope Rising
133.495m or MS
T(s) or Freq (Hz) if FFT
eSCOPE ELITE, www.AutomotiveTestSolutions.com
Get Cursors 0 Cursor
Cursor
Pan Hand
Zoom Window
Zoom In
Zoom Out
Zoom Out to Full
Zoom Set
Zoom to Set
Zoom Undo
Cursor Measurments
#1 (Val) 95.108
#2 (Val) 97.658
#1 - #2 2.550
Period (s) 133.495m
Freq (Hz) 7.491
Process Data ^ All
CH 1 OFF
CH 2 OFF
CH 3 ON
CH 4 OFF
CH 5 OFF
CH 6 OFF
CH 7 OFF
CH 8 OFF
Mark ON

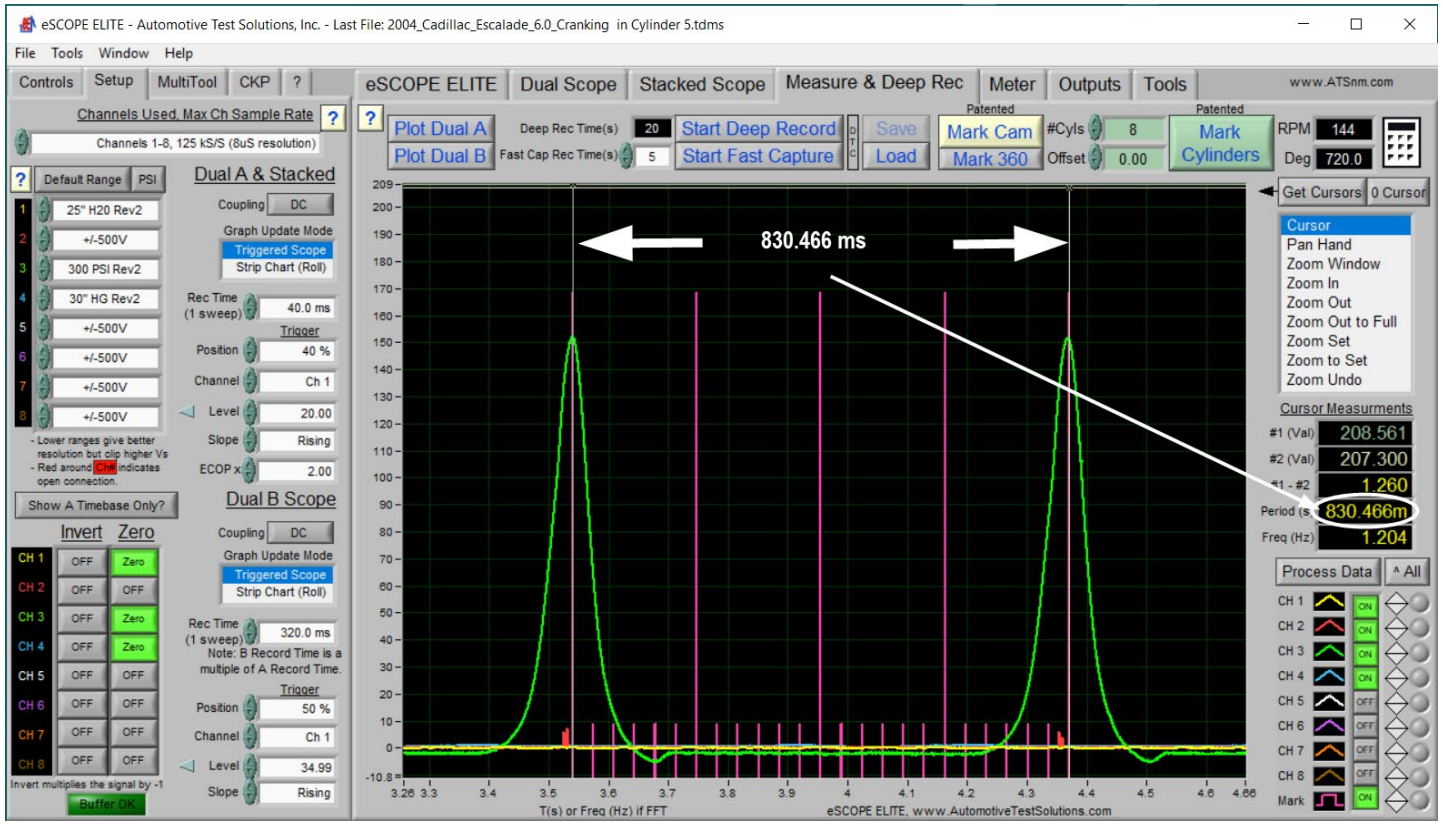
Understanding eSCOPE ELITE Sweep Time

I prefer to capture about 8 seconds of cranking compression to get a meaningful capture.
I placed the cursors at first compression tower and the last one, this comes to 7.454 seconds.



Understanding eSCOPE ELITE Sweep Time

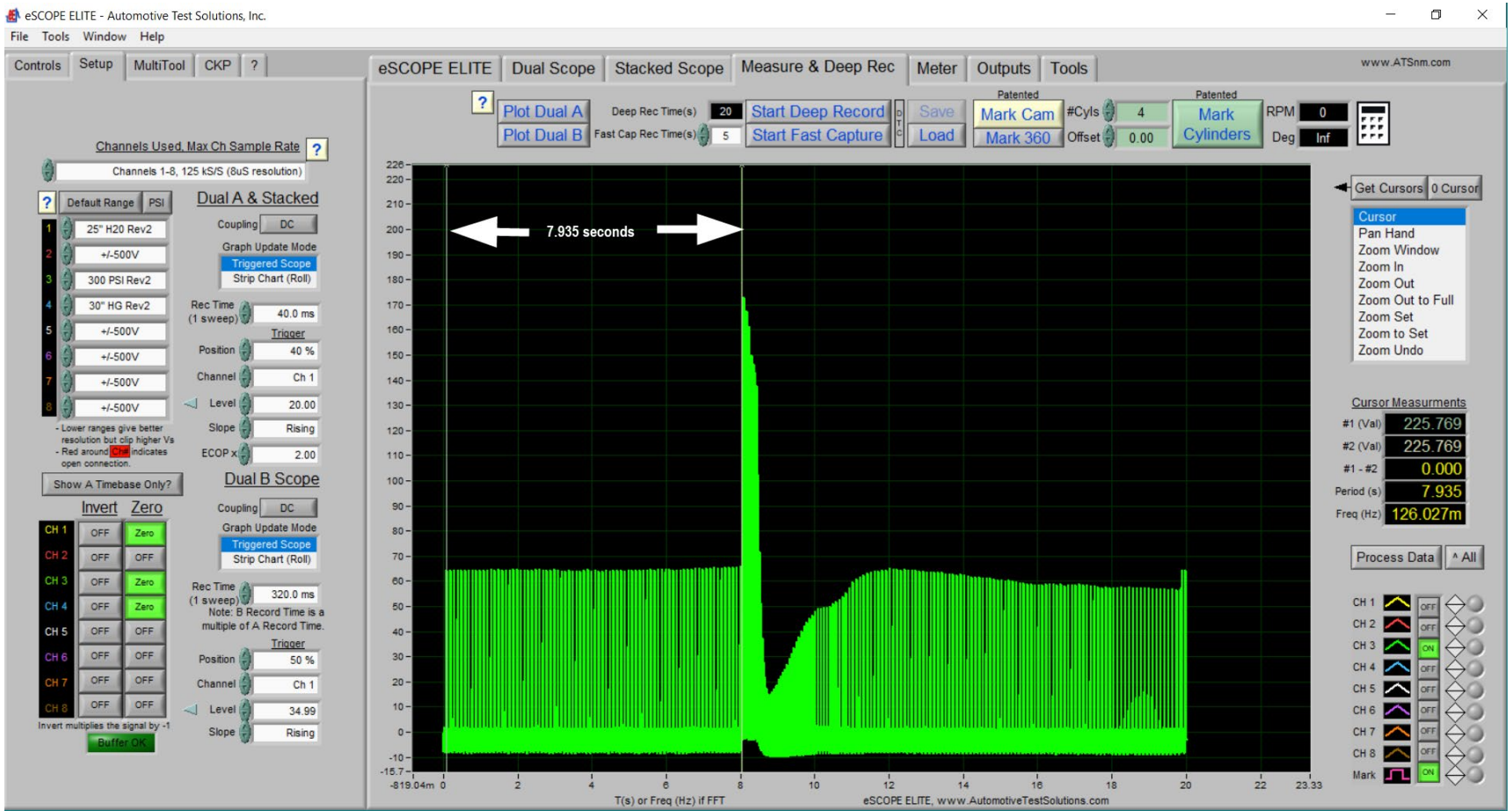
Here, I have zoomed in on two compression towers or just one crankshaft rotation (720°)
At 145 rpm cranking it took less than a second to complete one crankshaft rotation..



Understanding eSCOPE ELITE Sweep Time

Start thinking about an engine idling at say 900 rpm or a snap throttle of 3650 rpm and the same 720° rotation takes 133.524 ms. and 32.909 ms. respectively.

To capture a running compression capture which I refer to as an idle-snap-idle, I like to see 8 seconds of idle time then a quick snap followed by another 8 seconds of idle time or roughly a 20 second capture.

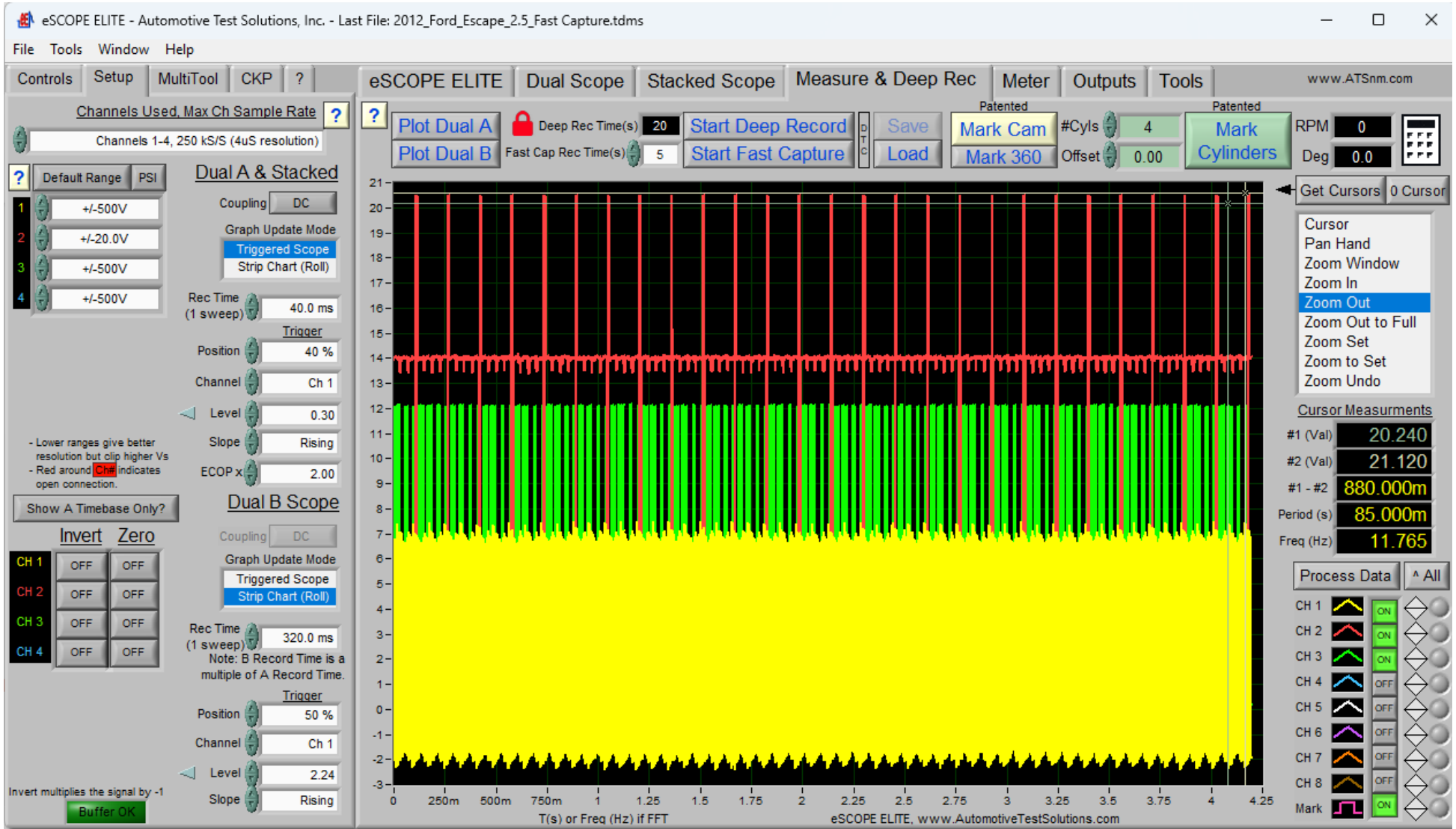


An engine cranking at 145 rpm completes a single 720° revolution in about 830.5 Milliseconds.

An engine idling at 900 rpm completes a single 720° revolution in about 133.5 Milliseconds.

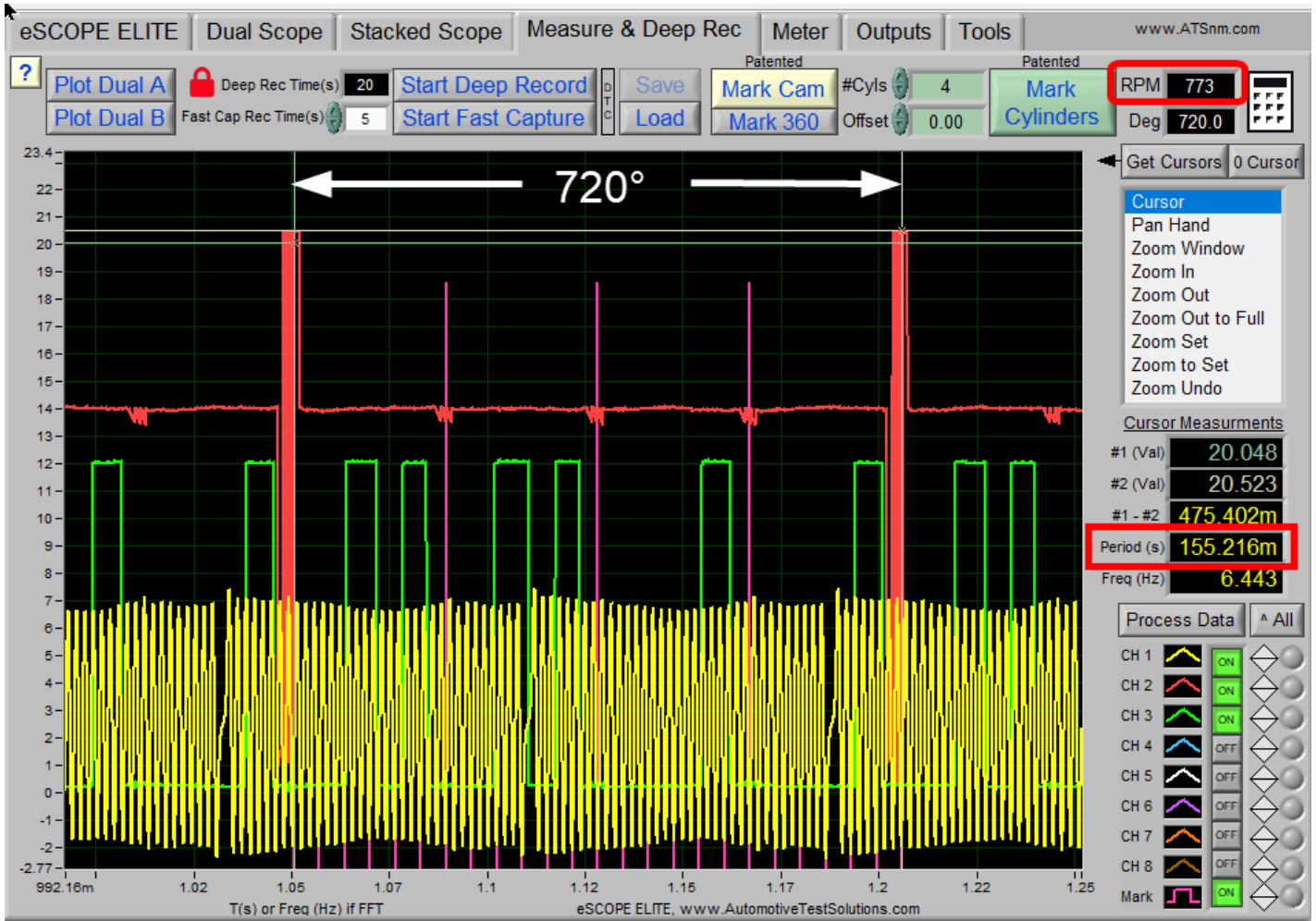
An engine running at 3650 rpm completes a single 720° revolution in about 32 Milliseconds.

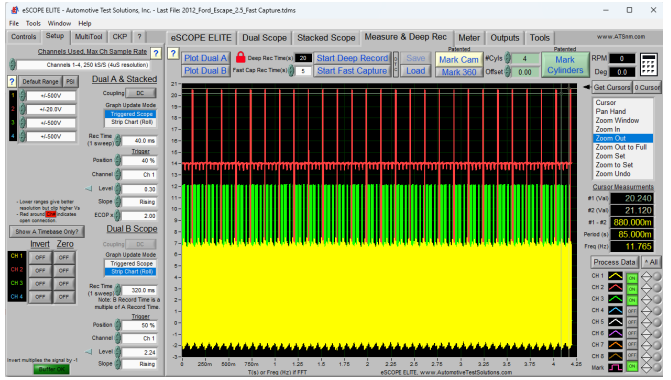
Below is a CKP-CMP-Ignition Coil Capture from a 2012 Ford Escape 2.5L Captured at 40 ms. Sweep Time



I hear all the time that 40 ms. Sweep Time is too fast or not enough time to capture data needed for a diagnosis.

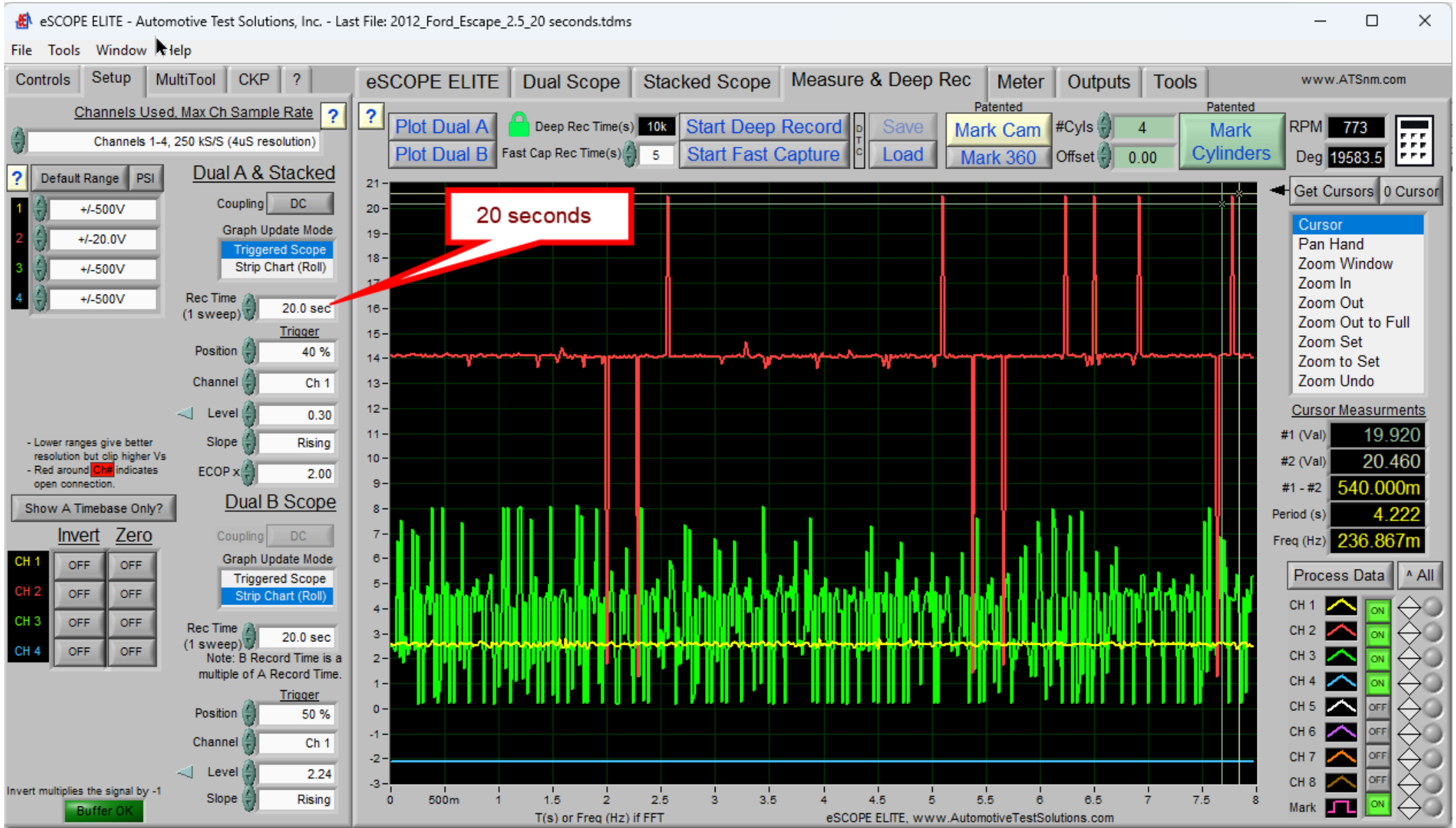
1. There is less than five seconds of data captured here.
2. There are 29 fire cycles in that brief amount of time..



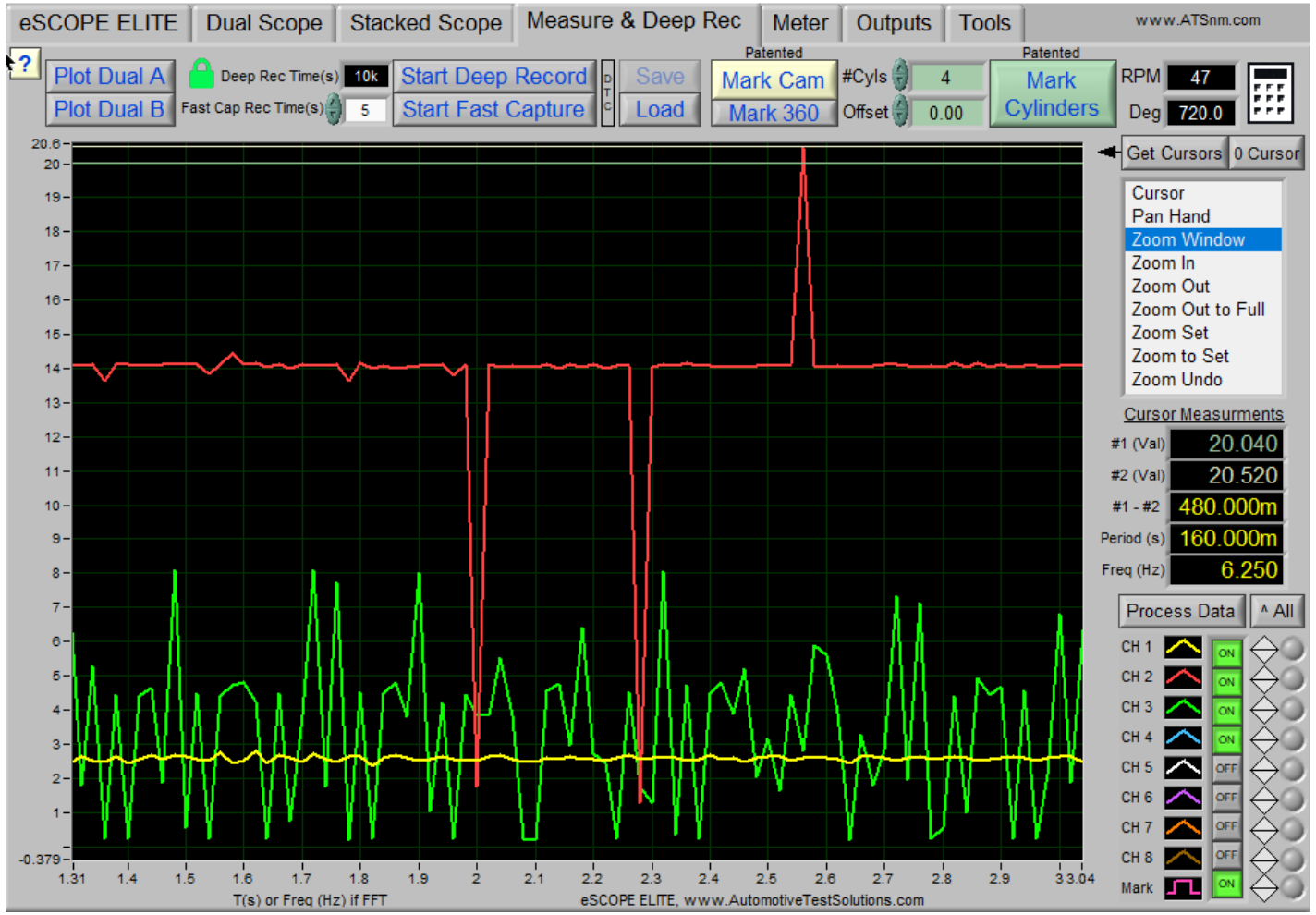


3. This engine is idling at 773 RPM
4. Each fire cycle or 720° took only 155.216 ms.
5. To check Cam to Crank correlation, you only need 720° certainly not 29 times that.

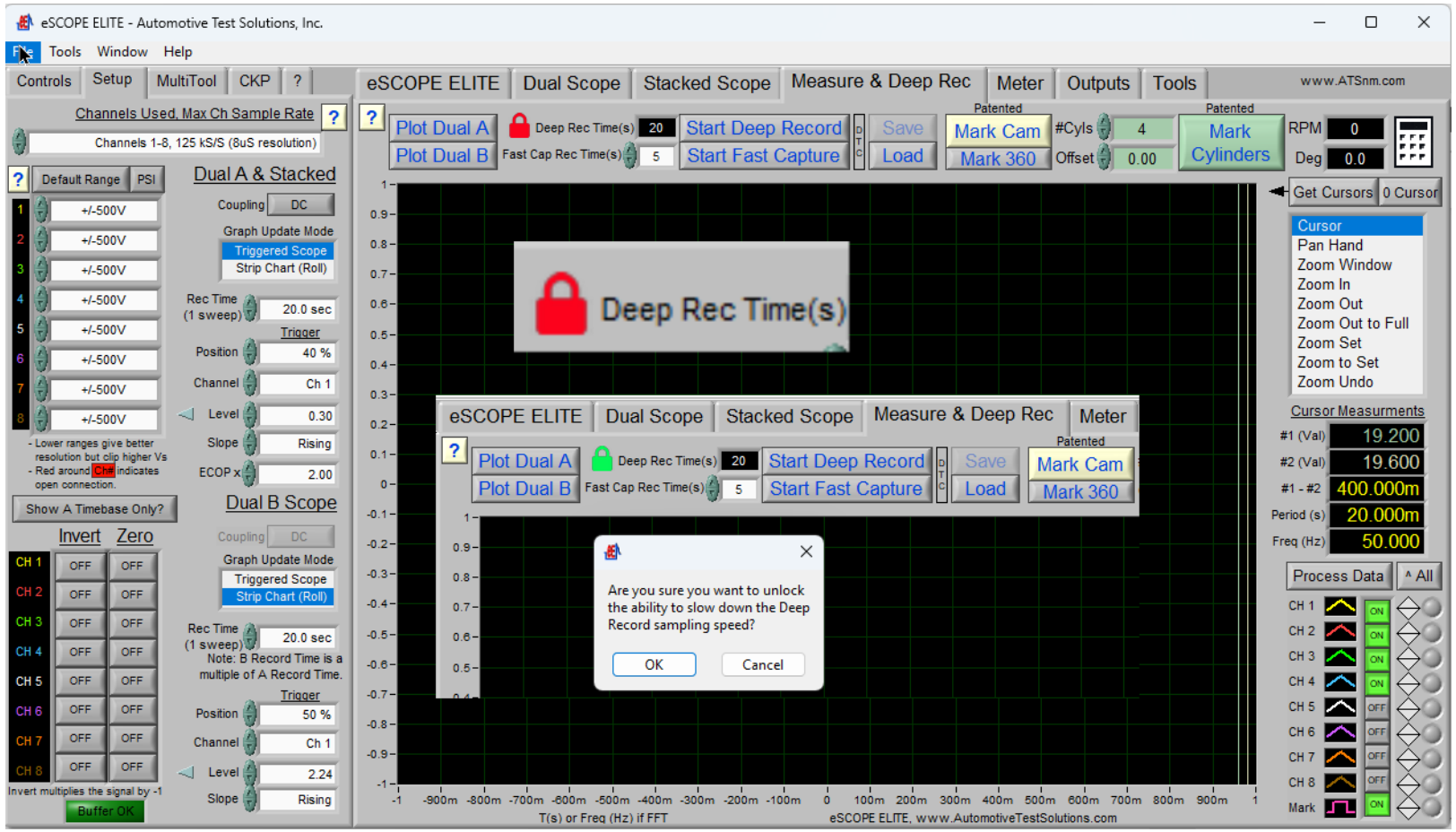
Here is the same CKP-CMP-Ignition Coil Capture at 20 second Sweep Time



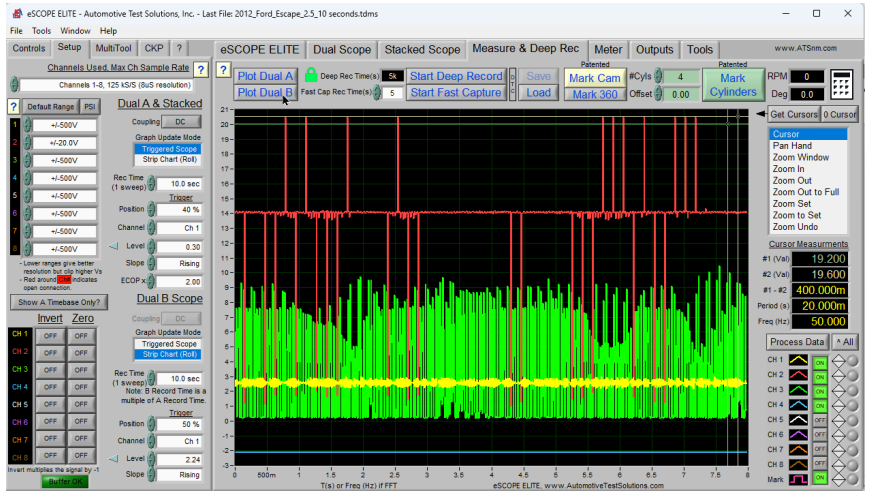
Here is the 20 second sweep time capture zoomed in, no useful data here at all. 20 seconds of sweep time is way to slow and equates to 2.77 hours of total capture time.



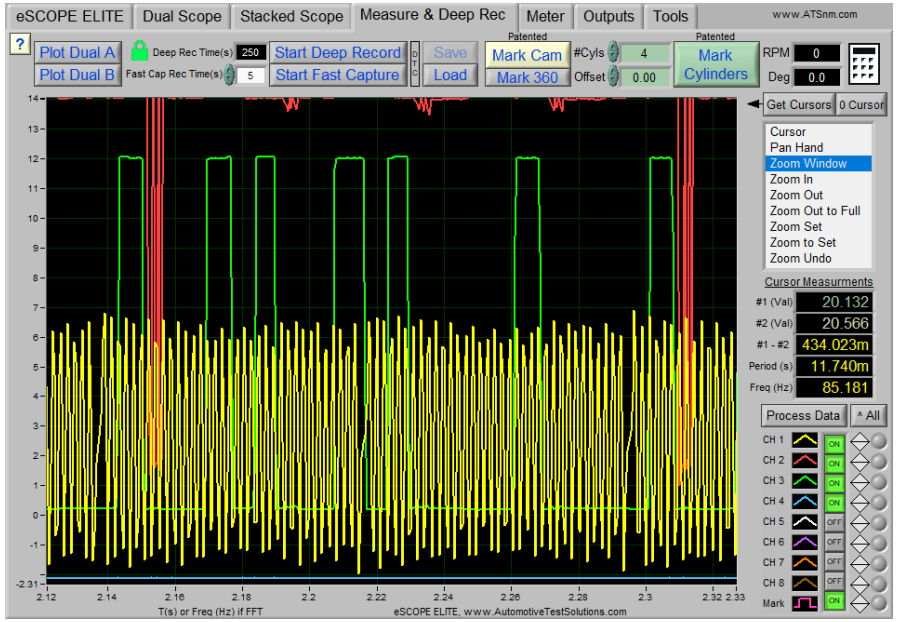
This happens so often on incoming support calls; our latest release has a “lock” you need to click on asking “Are you sure you want to unlock the ability to slow down the Deep Record sampling speed?” Answer “OK” and it is unlocked.

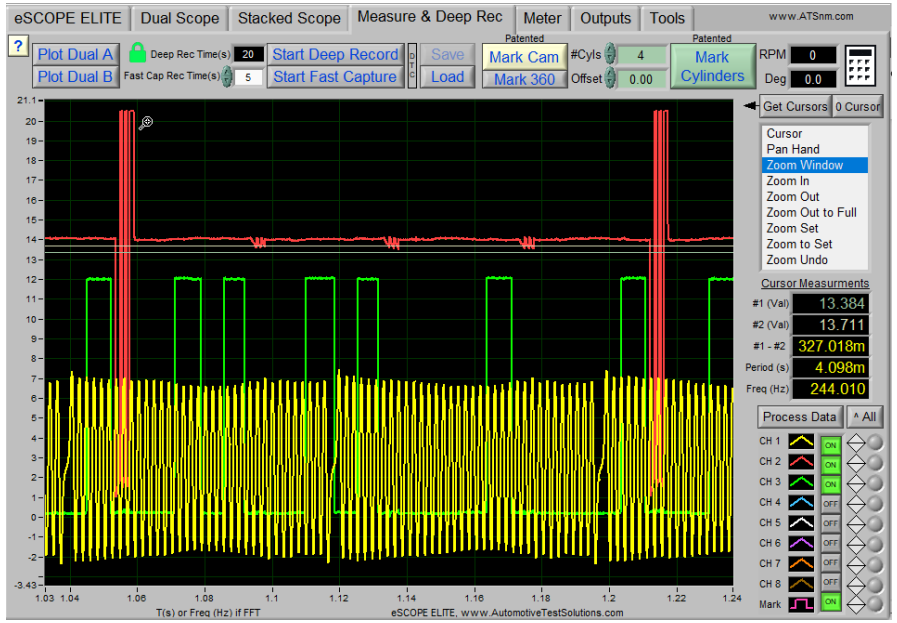


Here is the same CKP-CMP-Ignition Coil Capture at 10 second Sweep Time



Even at 500 ms. (1/2 Second) you will notice the CKP distorted compared to the same at 40 ms.





Start thinking about how fast events happen on a running engine and you will begin to understand the correct sweep times for the data you are using to diagnose.