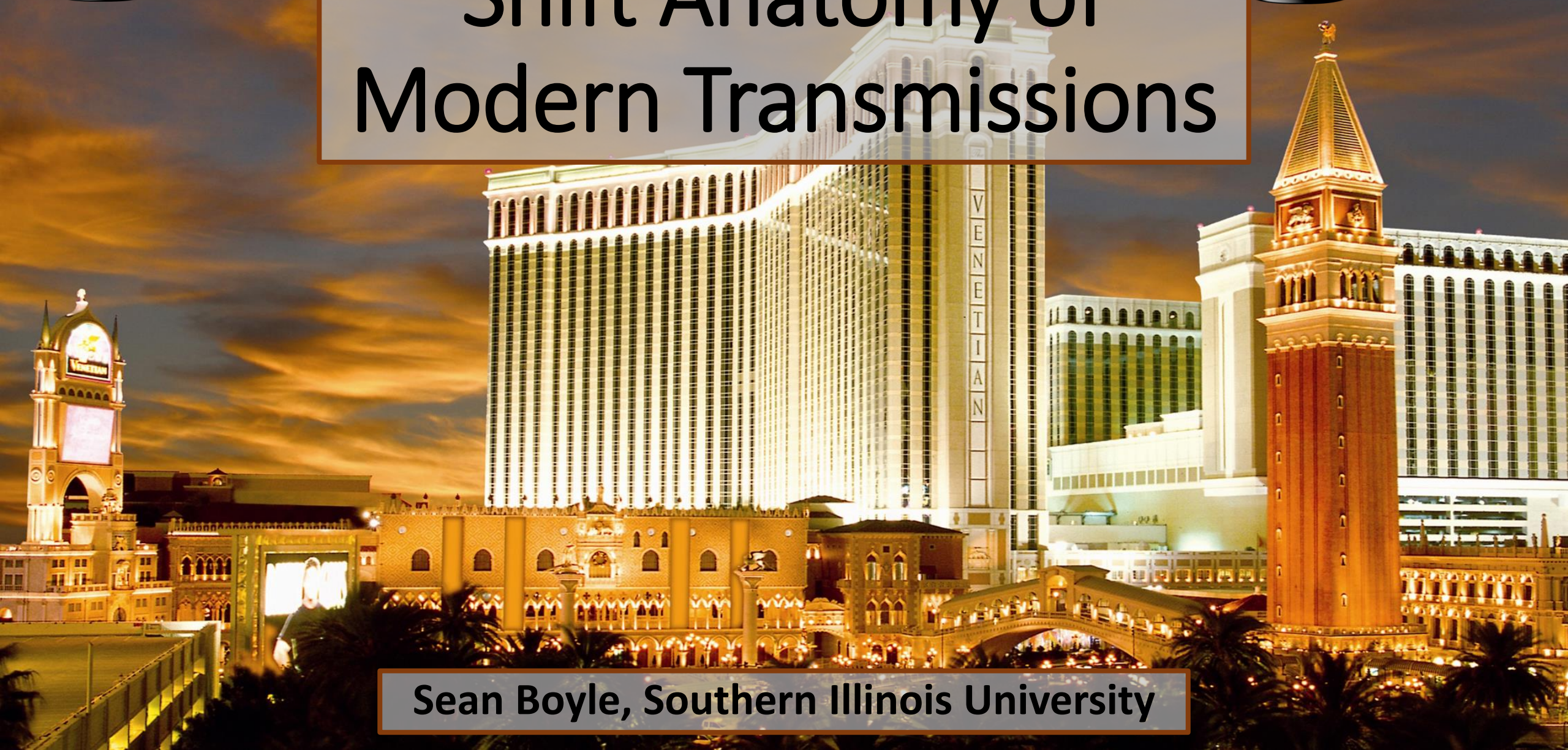




Shift Anatomy of Modern Transmissions

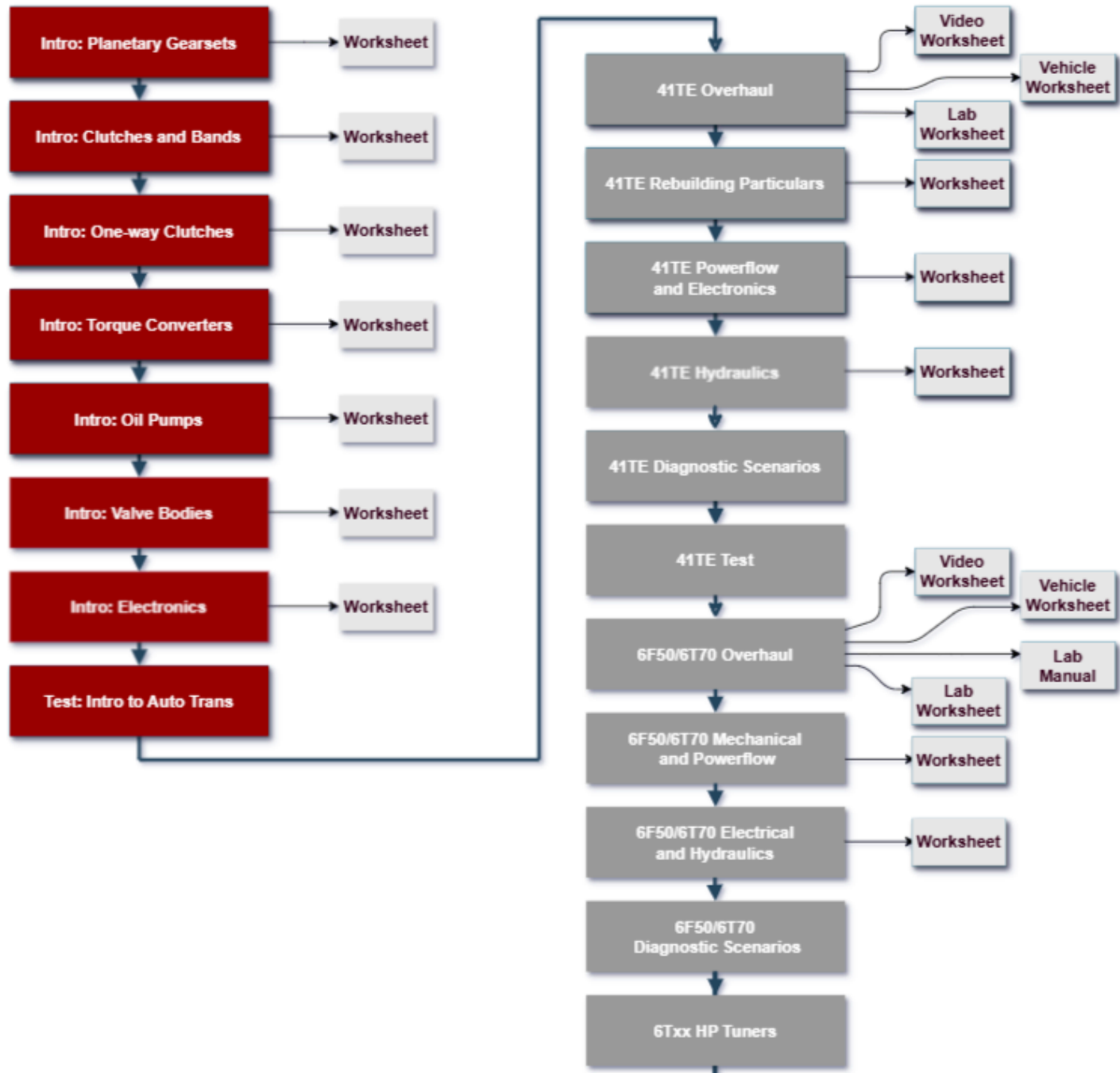


Sean Boyle, Southern Illinois University

Southern Illinois University - SIU

- 4-year Automotive Technology Program
 - **Not engineering**
 - Service focused, but includes management training
 - Many transfer AAS students
- Opportunity for faculty to dig deeper into operation and diagnosis

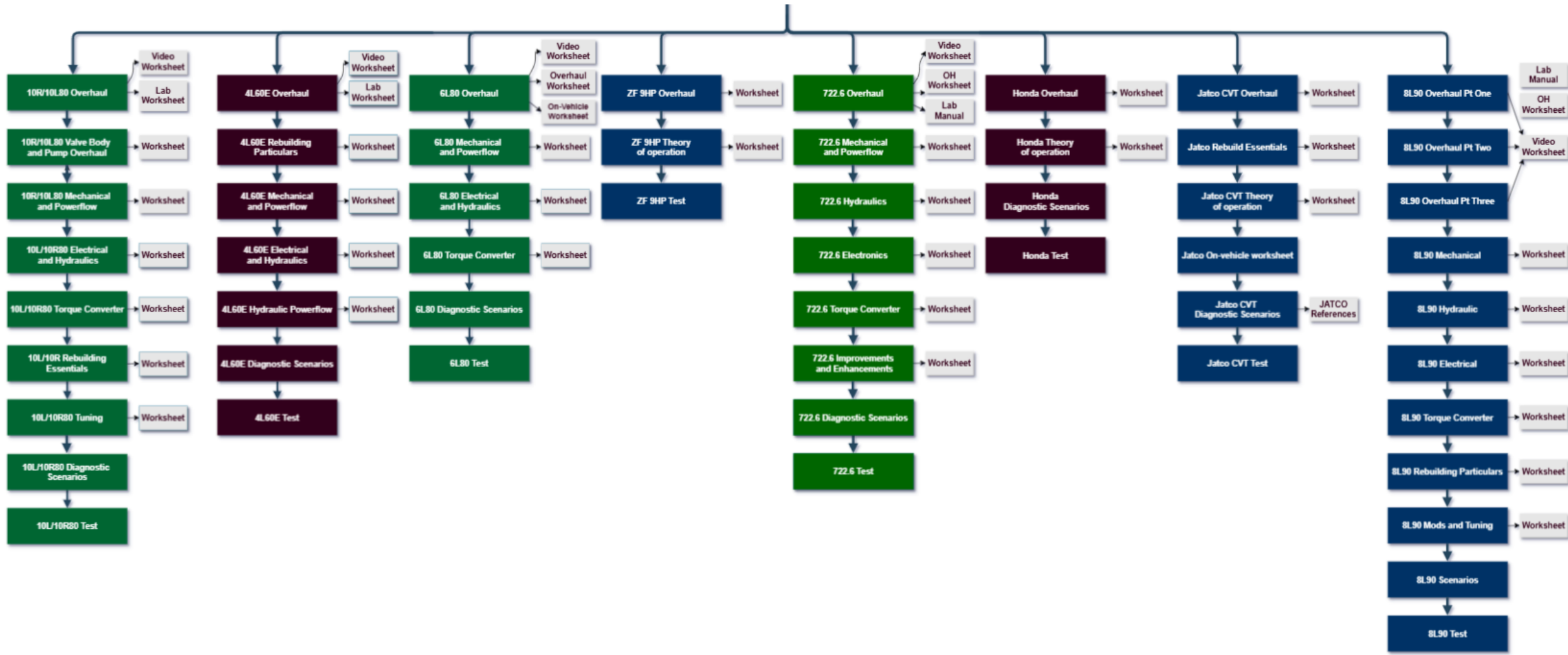
Automatic Transmission Curriculum



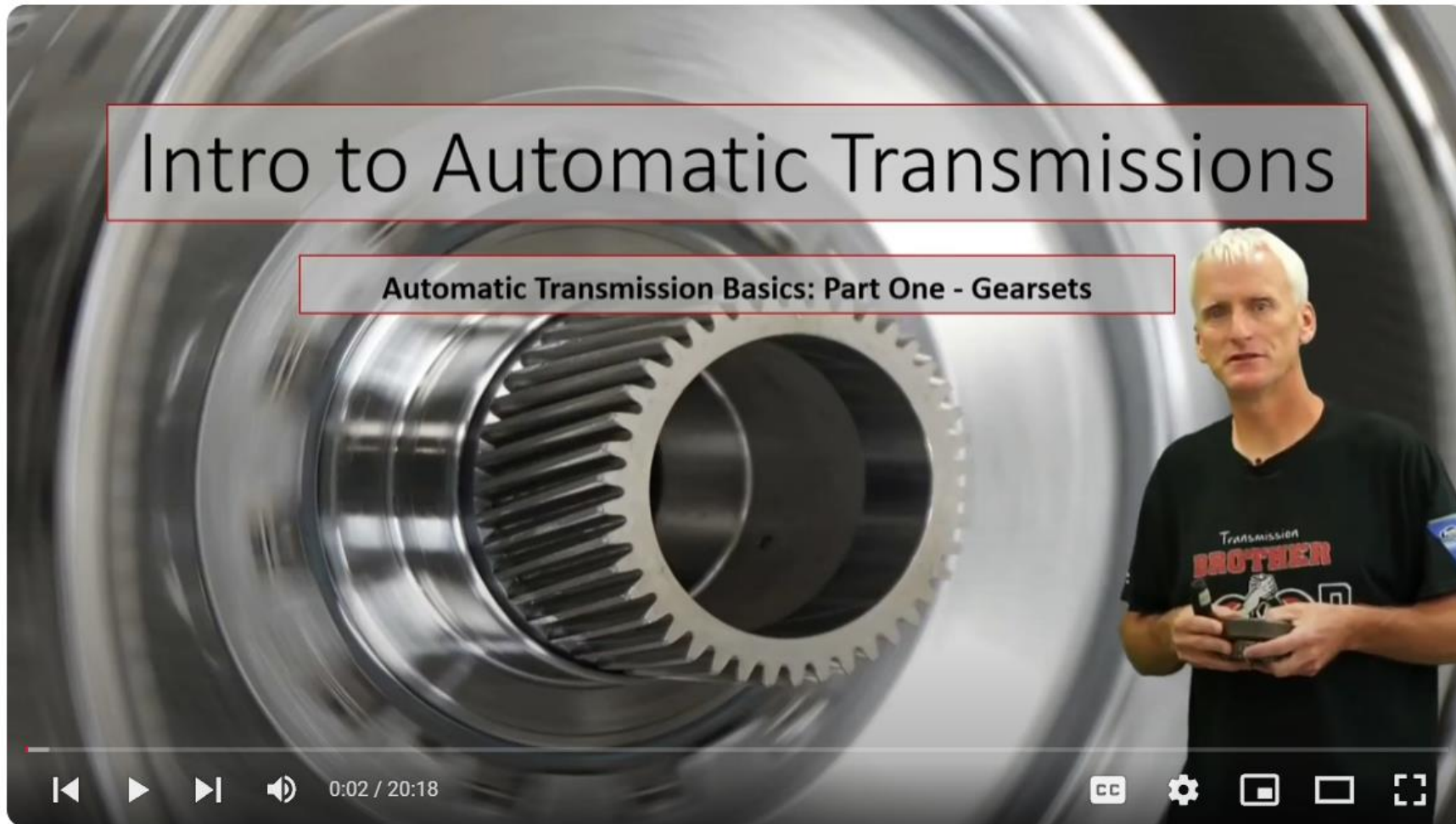
Color Legend

-  More challenging, but more rewarding!
-  Intermediate level of challenge
-  Easiest to understand and digest
-  Required intro curriculum

Southern Illinois University - SIU



YouTube: siu automotive










overlay

Automatic Transmissions

siu automotive - 1 / 60

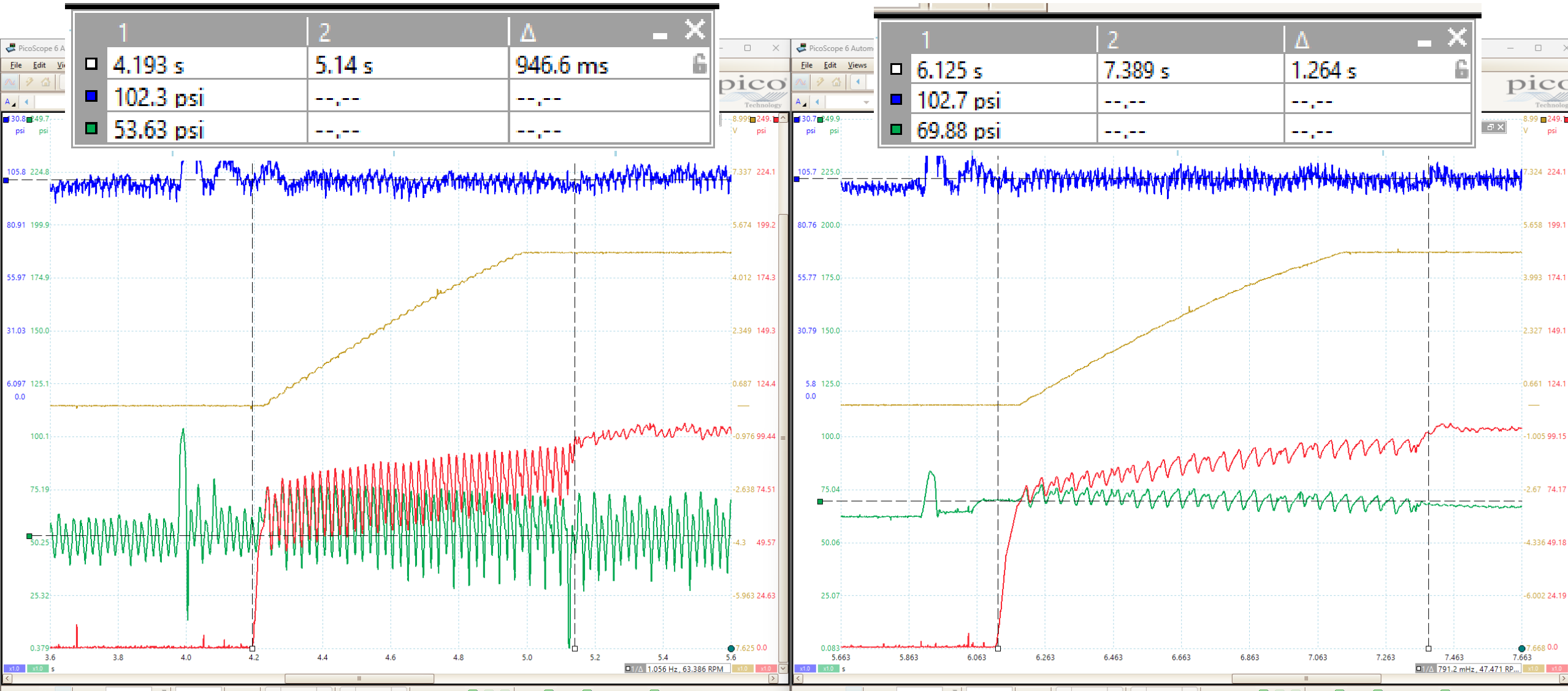
↺ ↻

- ▶  **Basic planetary gearsets**
siu automotive
20:19
- 2  **Basic auto trans clutches and bands**
siu automotive
12:41
- 3  **Basic one-way clutch operation**
siu automotive
8:34
- 4  **Basic torque converter operation**
siu automotive
41:59
- 5  **Basic auto trans oil pump operation**
siu automotive
10:15
- 6  **Basic auto trans valve bodies**
siu automotive
34:07
-  **Basic auto trans electronics**

Shift Control Evolution

- Hydraulically controlled transmissions
 - Pressure increase for holding force
 - Clutch count/surface area
 - One-way clutches (shift feel)
 - Accumulators
 - Orifices
 - Wave/dished steels
 - Piston return springs
- Modern Electronically Controlled transmissions
 - Torque Management
 - Throttle and spark advance
 - Solenoid control
 - Reduced pressure during the shift
 - Specific phases of a shift
 - Wave/dished steels
 - Balance pressure
 - Piston return springs

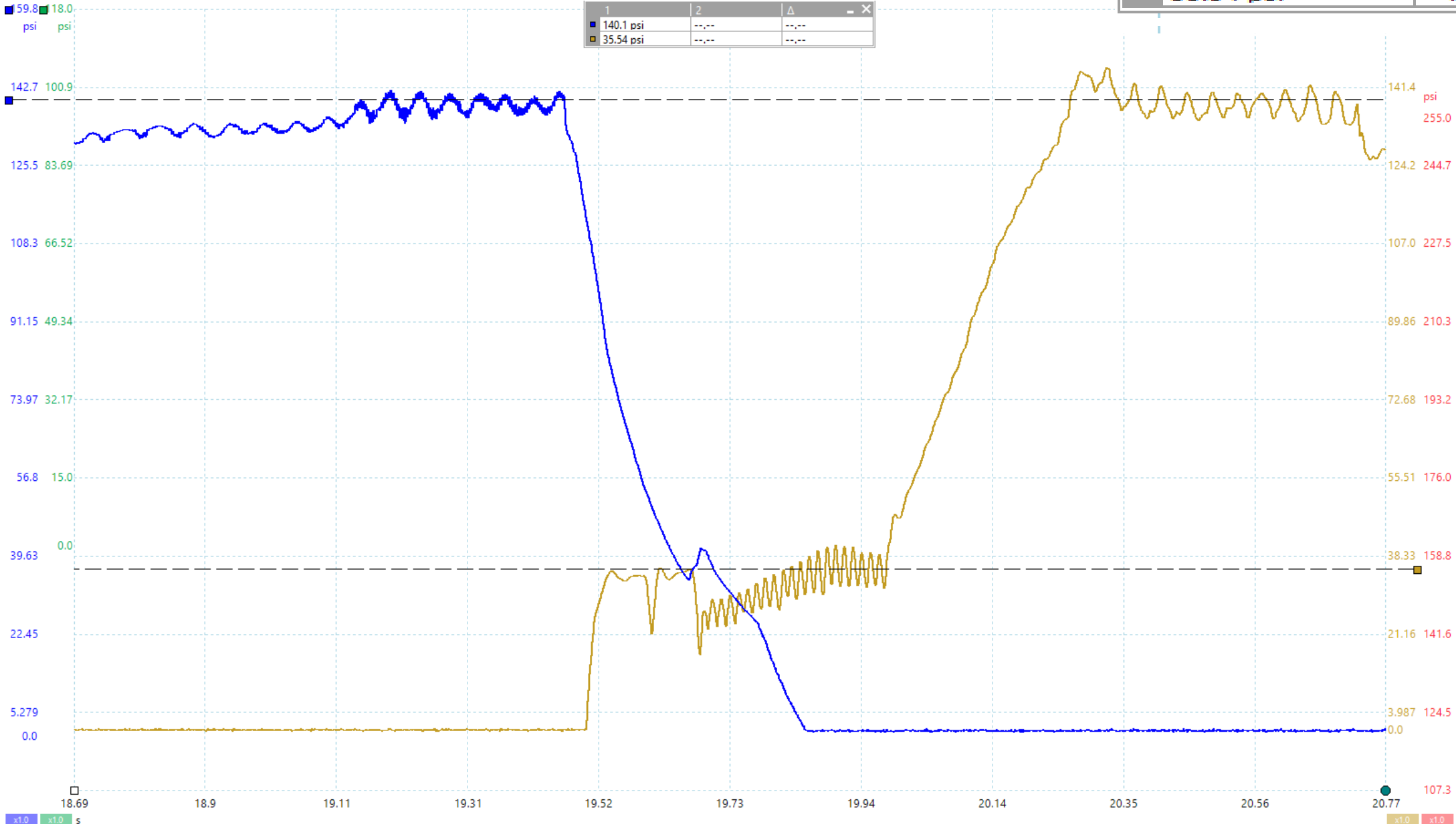
Evolution 4L60e 3-4 shift



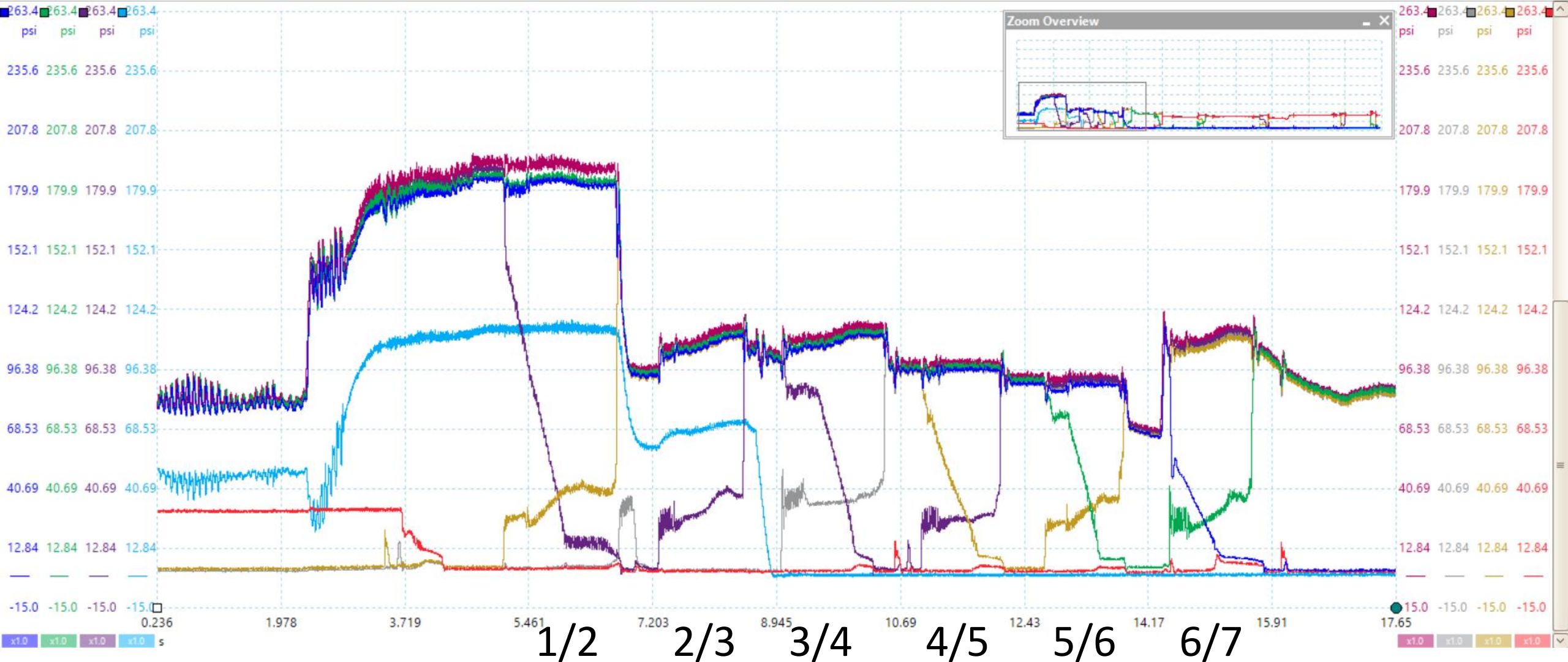
Evolution – 42RLE 1-2 Shift

	1	2	Δ
■	140.1 psi	---	---
■	35.54 psi	---	---

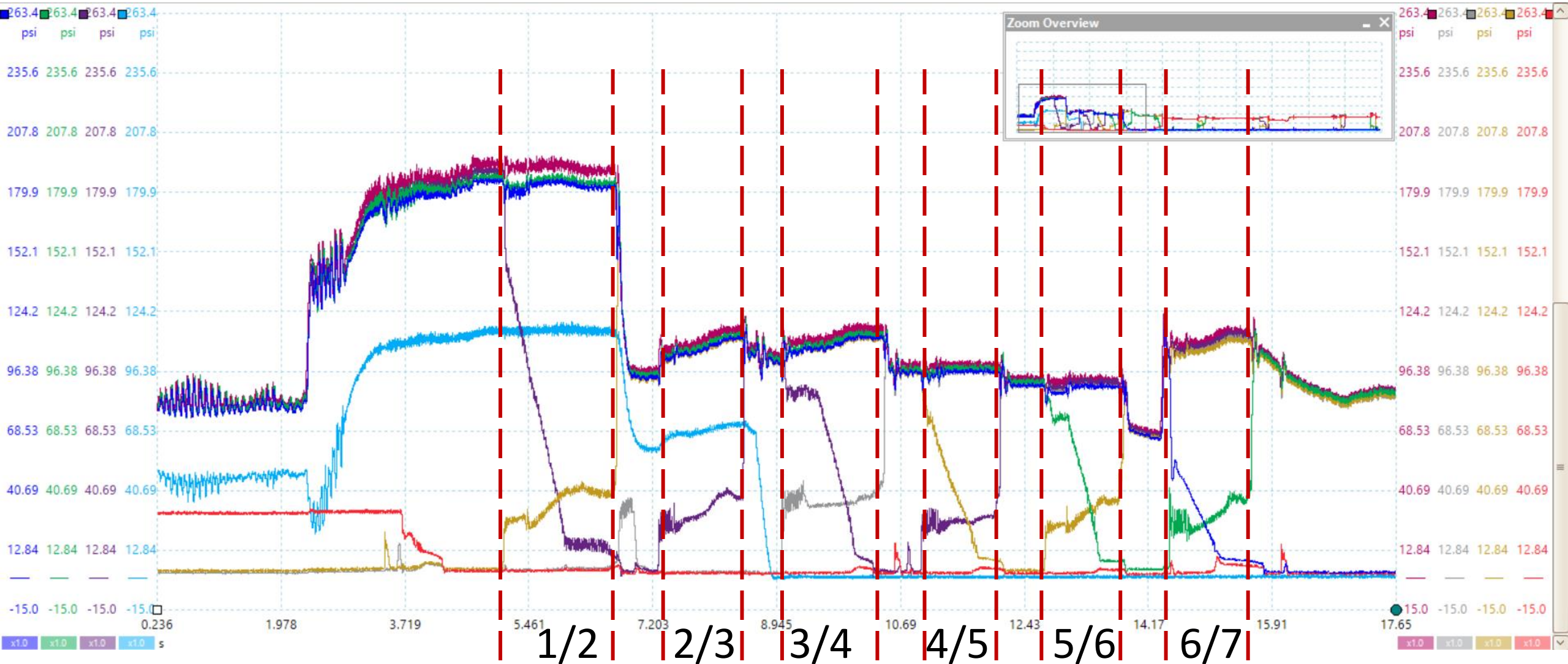
	1	2	Δ
■	140.1 psi	---	---
■	35.54 psi	---	---



Evolution – 10L80



Evolution – 10L80

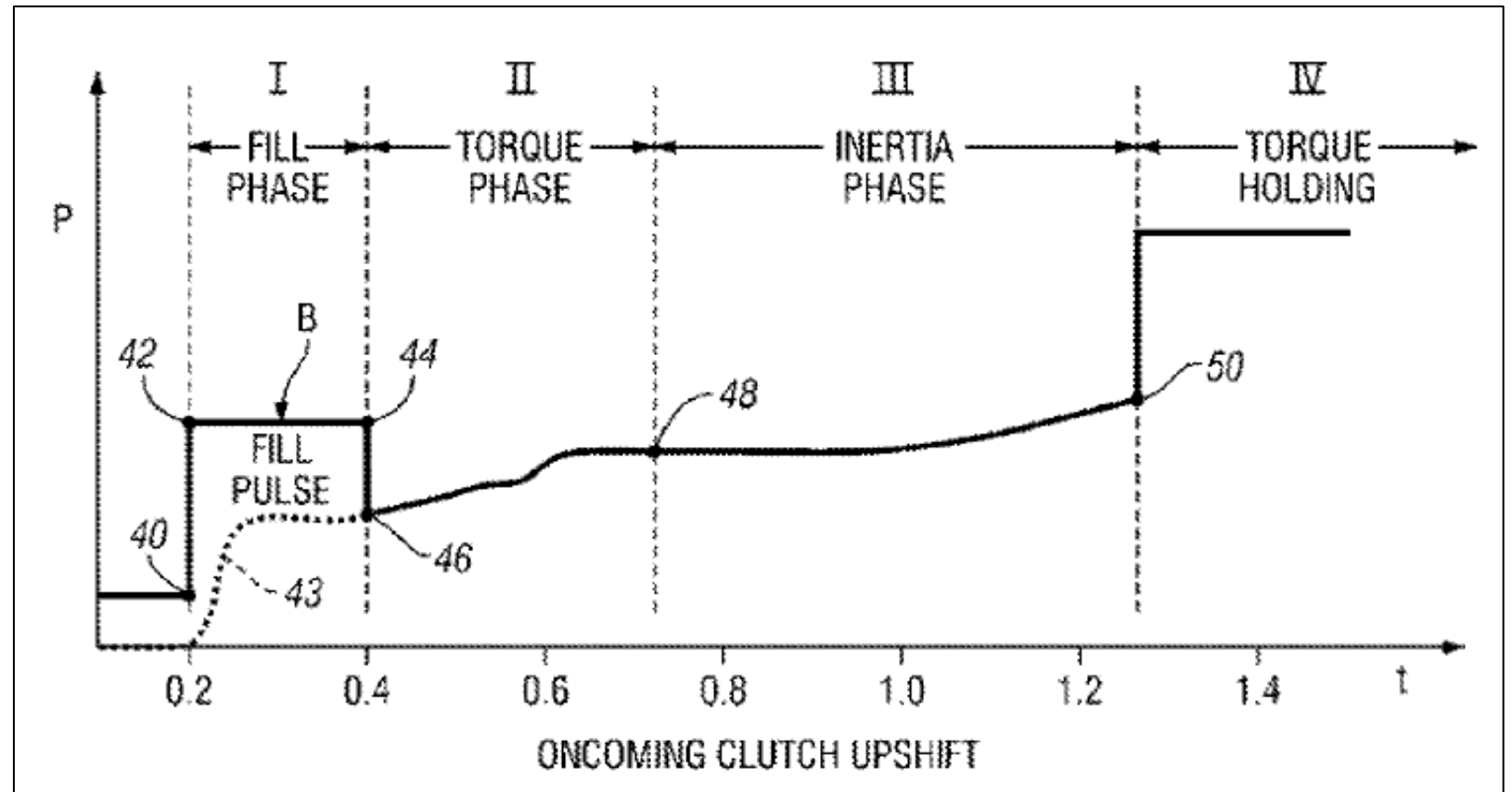


Look how much of this 10 second acceleration is just shifting!

Modern Trans - What controls clutch feel?

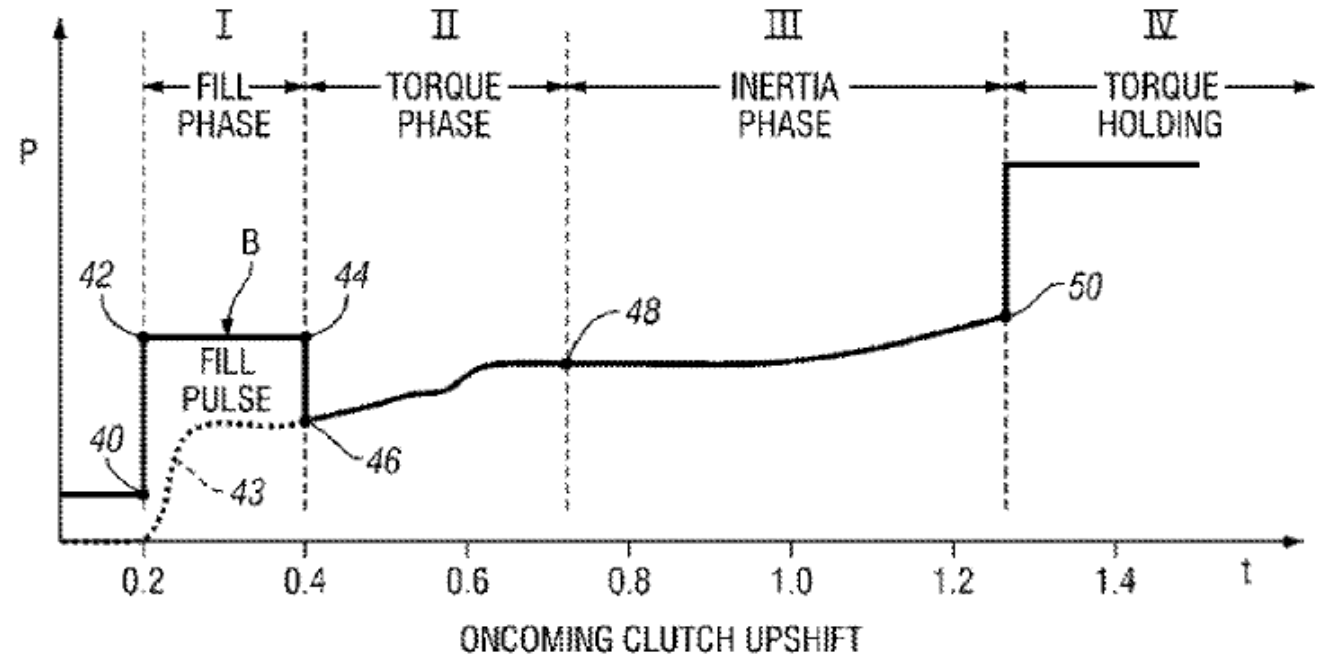
- No accumulators!
- Balance Pressure
- Piston return springs
- Wave/Dished Springs
- Torque Management

- Clutch pressure control
 - Applying (oncoming) clutch pressure
 - Releasing (off going) clutch pressure

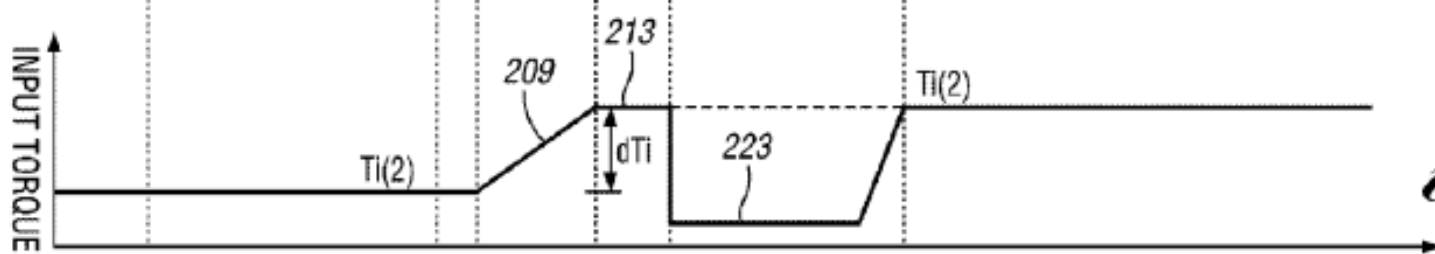
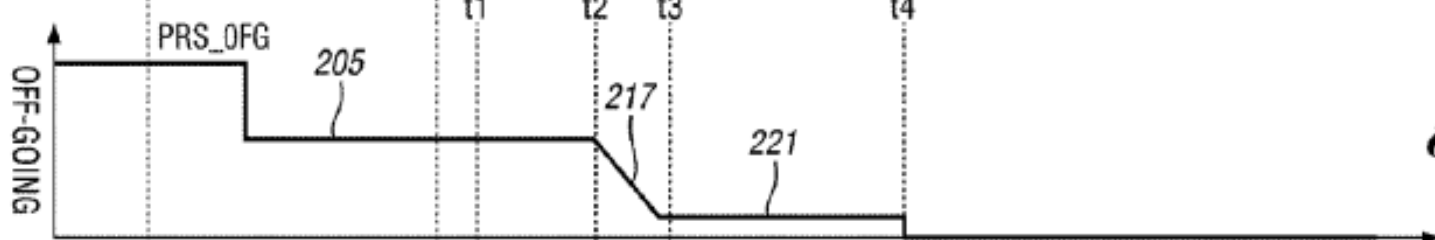
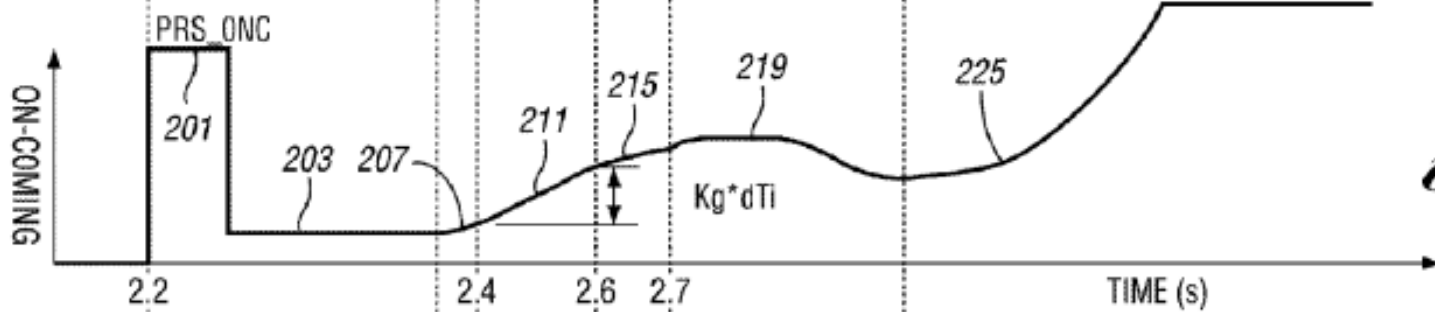
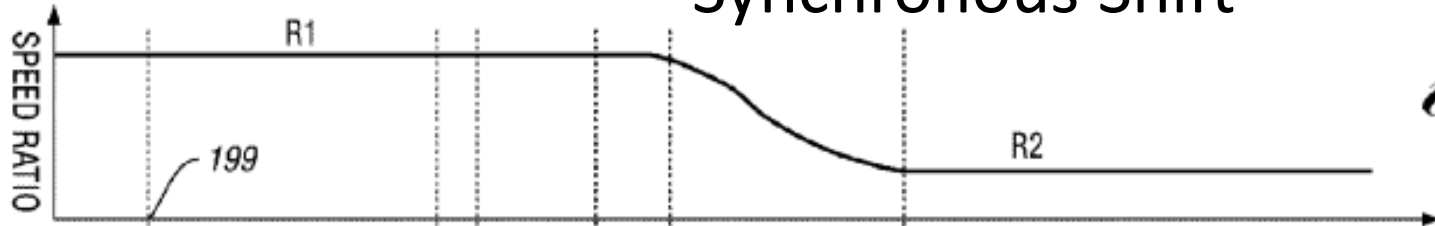


What controls clutch feel?

- Fill phase – fill the clutch with fluid, compress the piston return spring
- Torque phase – on-coming pressure rise and off-going drop. No ratio change at this point. *Torque hole* because of bind-up and heat.
- **Inertia phase – ratio change, engine speed drops, torque management portion**
- Torque holding – after ratio change, keeps the clutches from slipping



Synchronous Shift

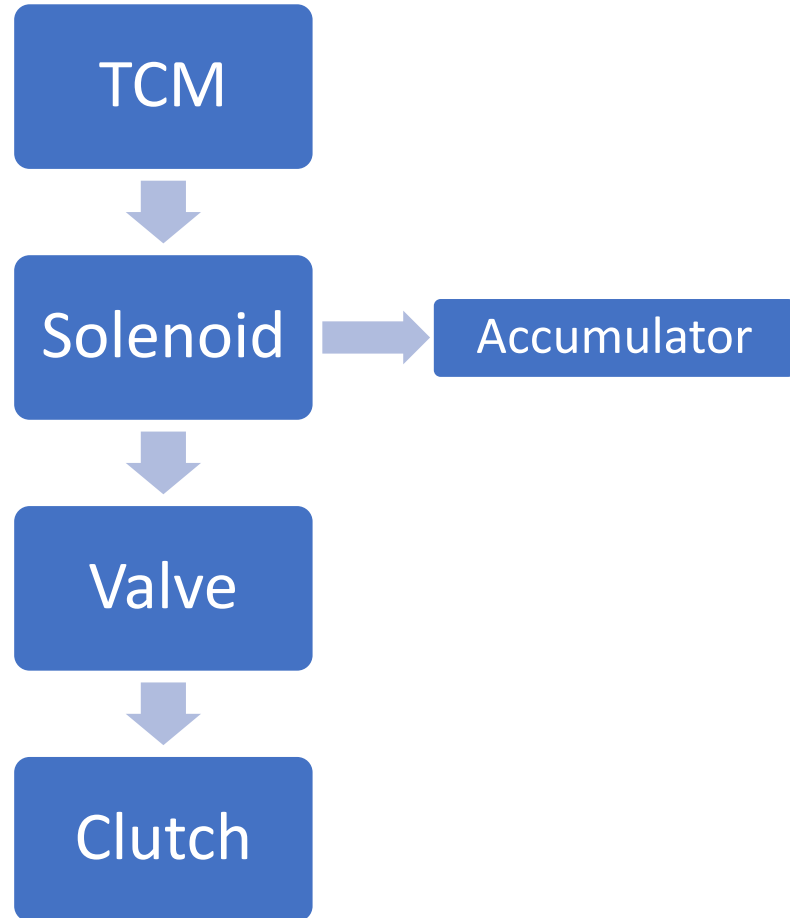


↑ Shift command

Torque Phase

Inertia Phase (speed ratio change)

Electronic Operation – Hyd Solenoids



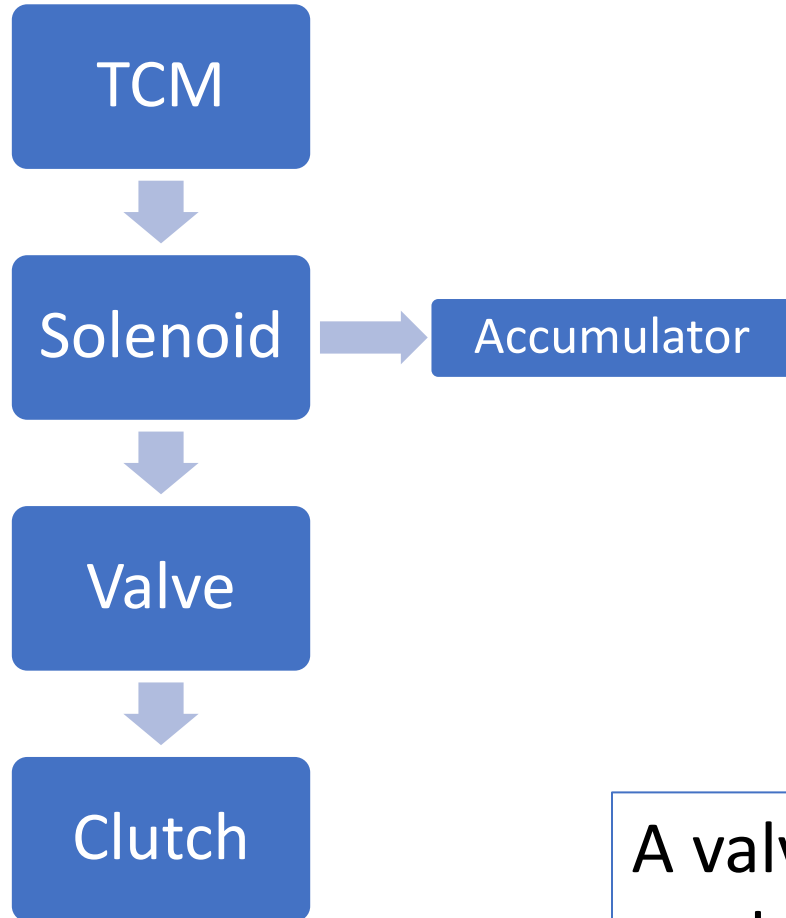
Line Pressure or Backfill
Pressure to clutch

Solenoid Pressure OUT

AFL or Line
pressure IN



Electronic Operation – Hyd Solenoids

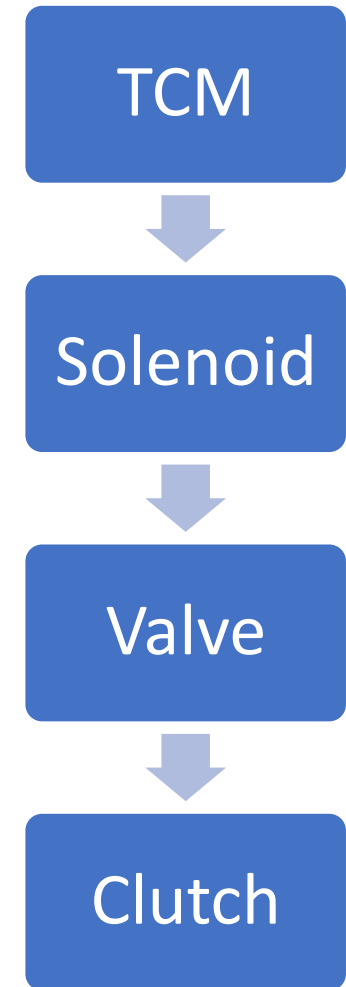


A valve within the solenoid directs hydraulic pressure to work on another valve to control line pressure to a clutch

Electronic Operation – Linear Solenoids (10R)



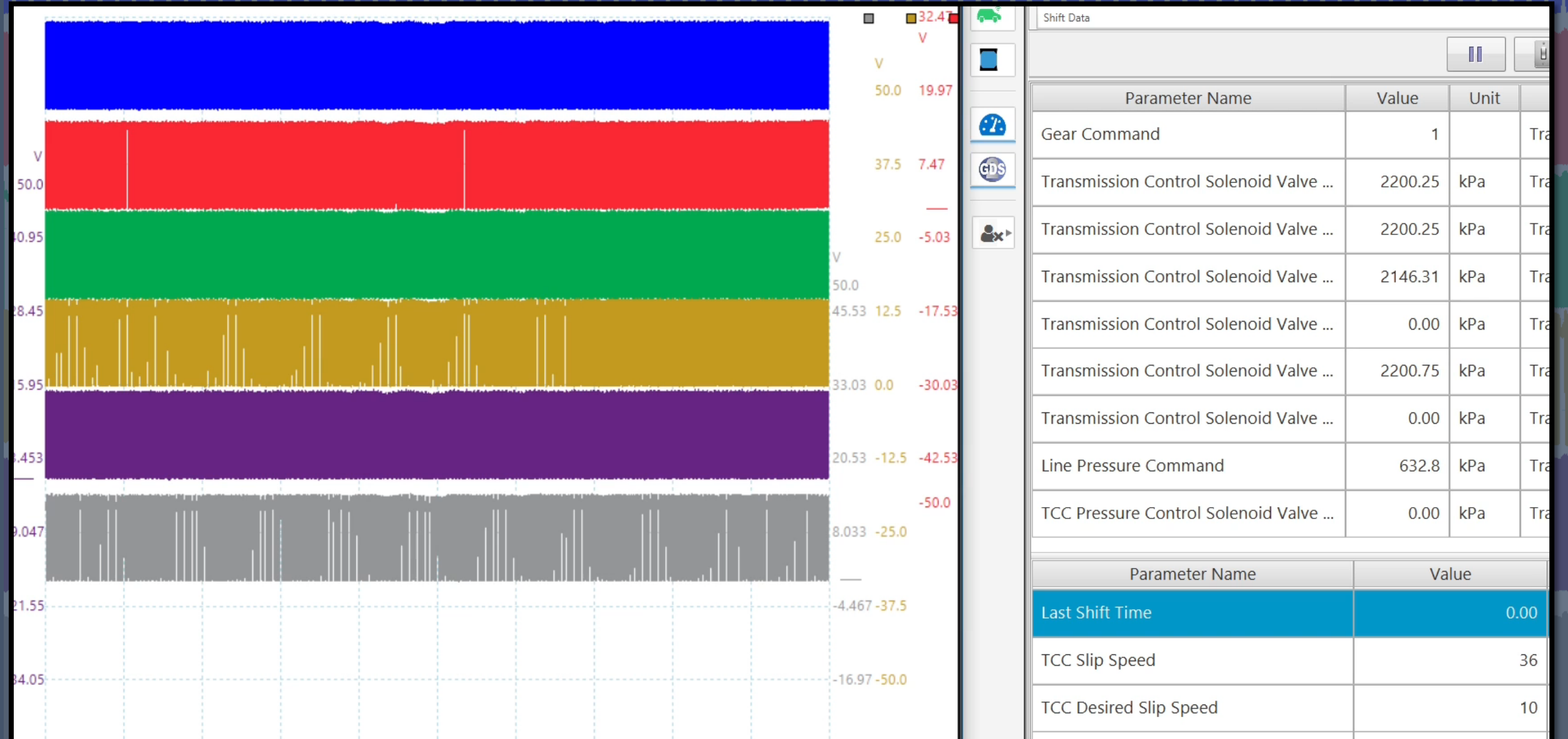
Linear Solenoids use a mechanical pintle to push on the hydraulic valve. Nothing new, Toyota and Honda has been doing this for a while. The 10R/L doesn't use springs to return the valve/pintle. Backfill pressure is used to return



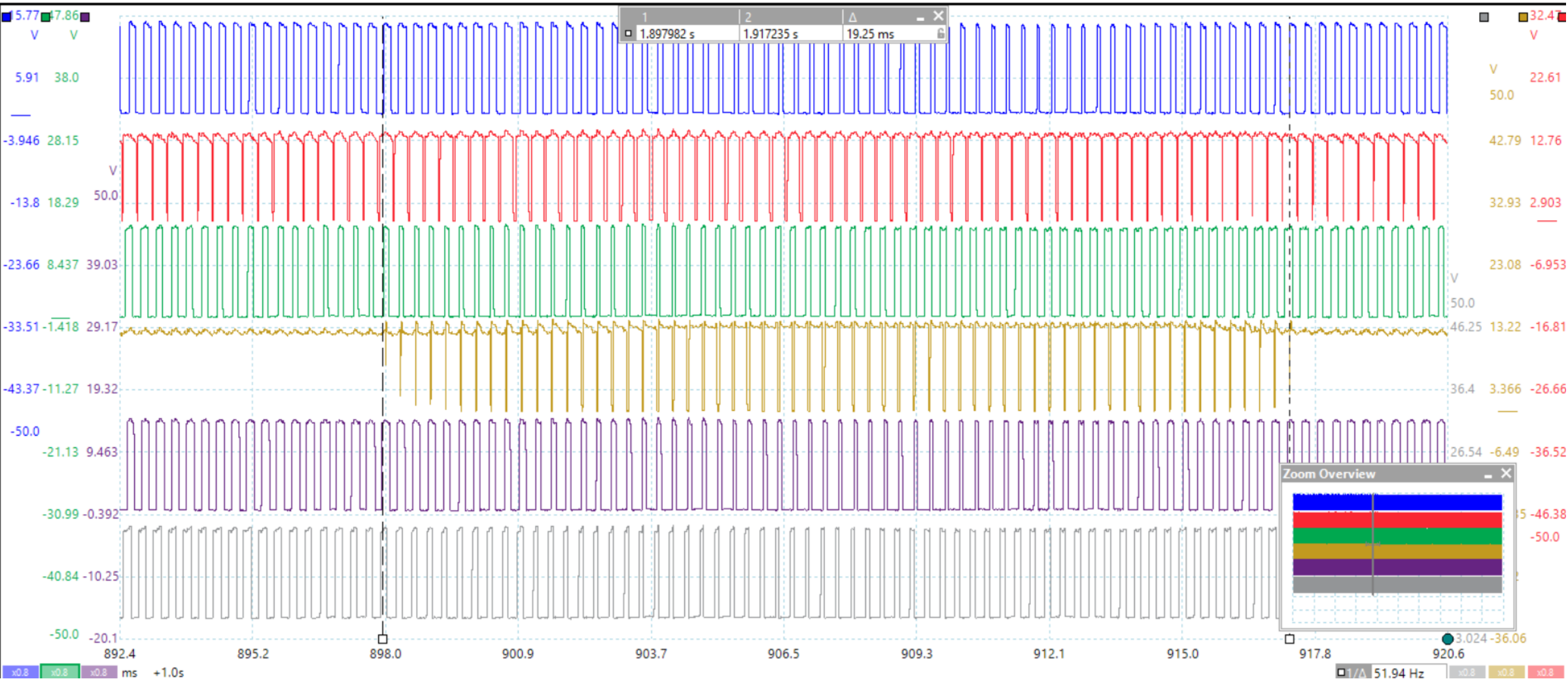
10L/10R TCM Control - PWM



10L/10R Outputs – Solenoid Control

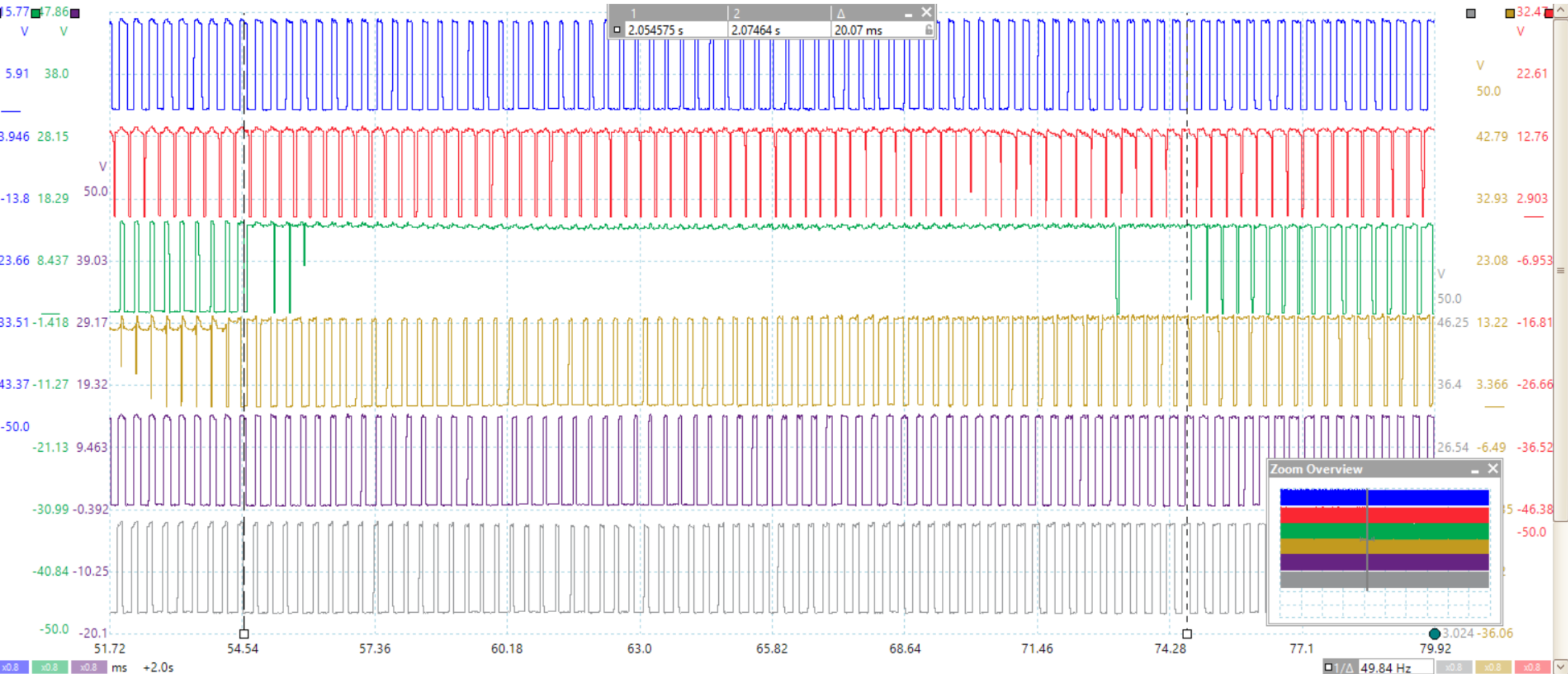


10L Solenoid Control – Electrical 5-6 shift C ON, D OFF



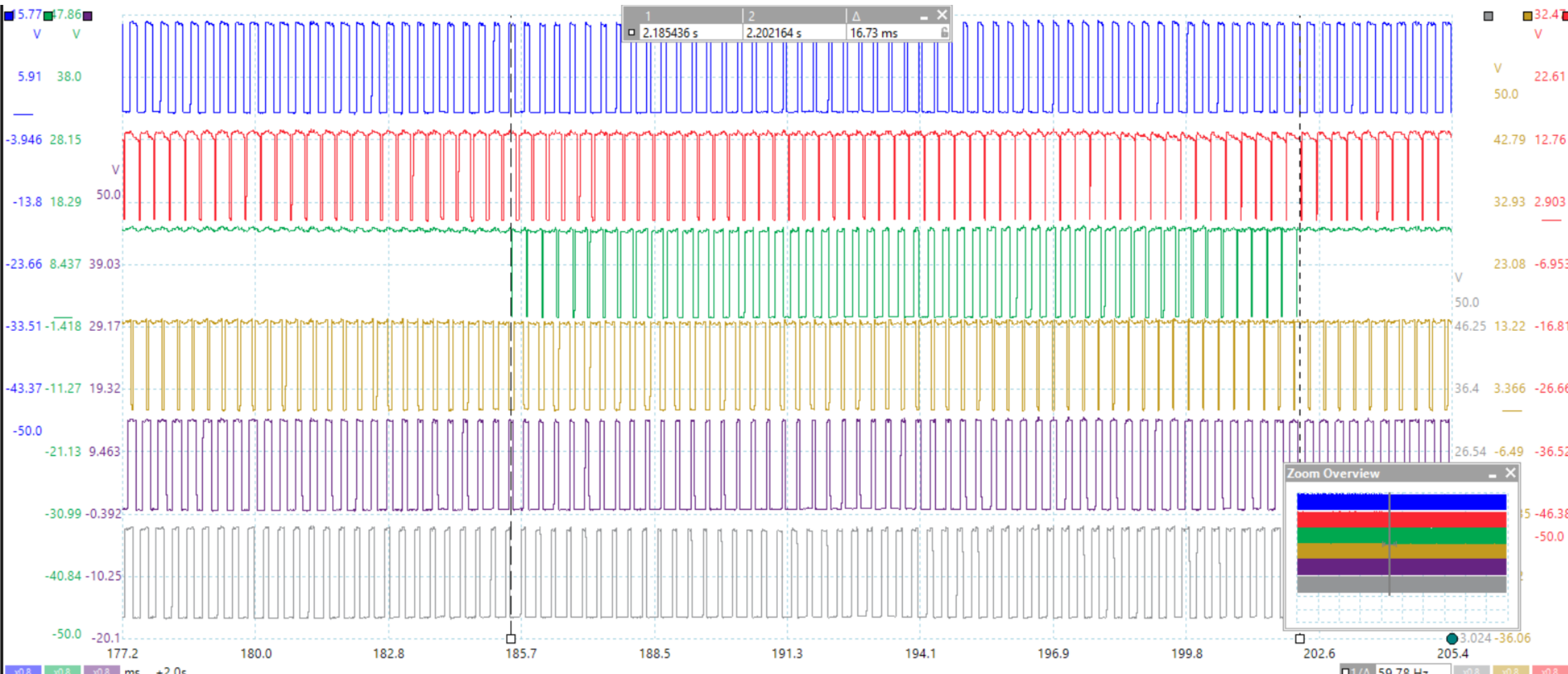
10L Solenoid Control – Electrical 5-6 shift

C modulates OFF, D modulates ON (fill phase)



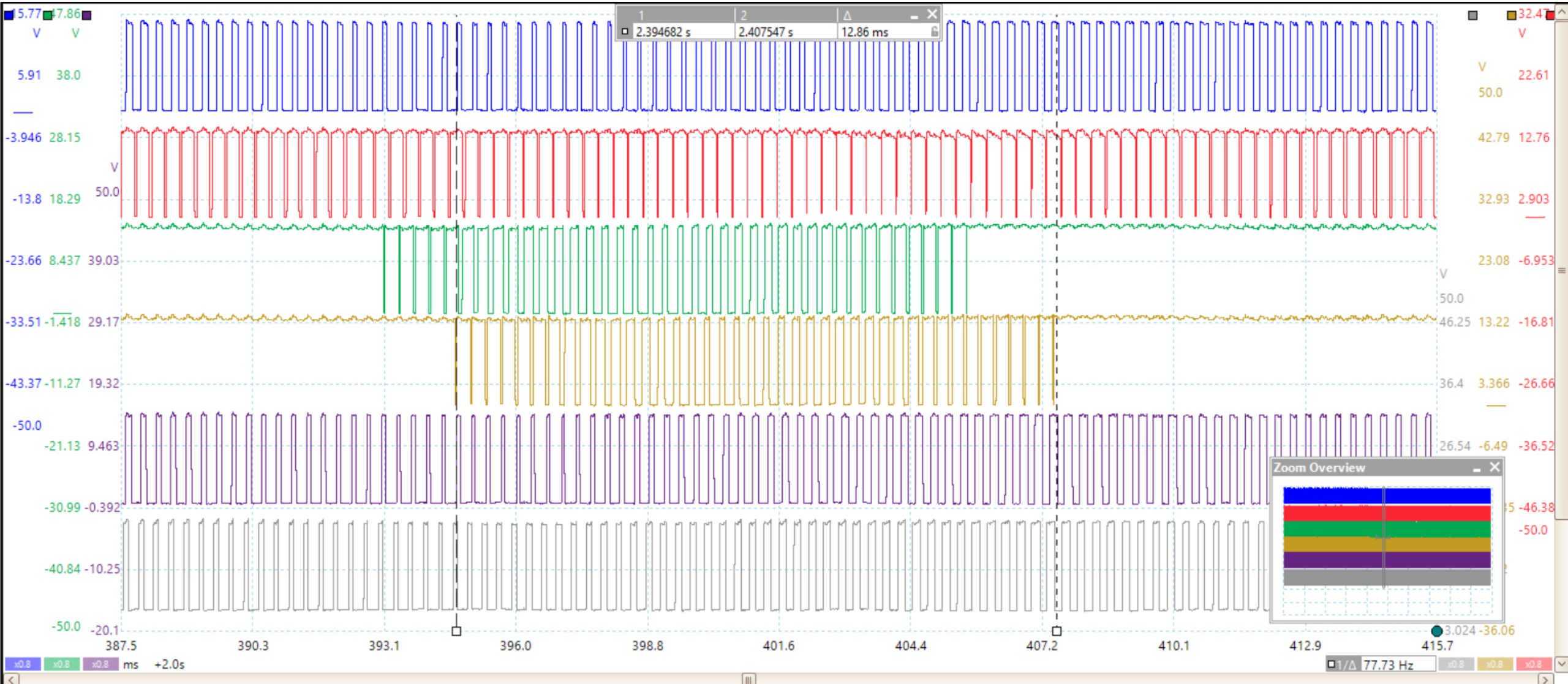
10L Solenoid Control – Electrical 5-6 shift

C modulates OFF (torq phase), D modulates ON (torq phase)



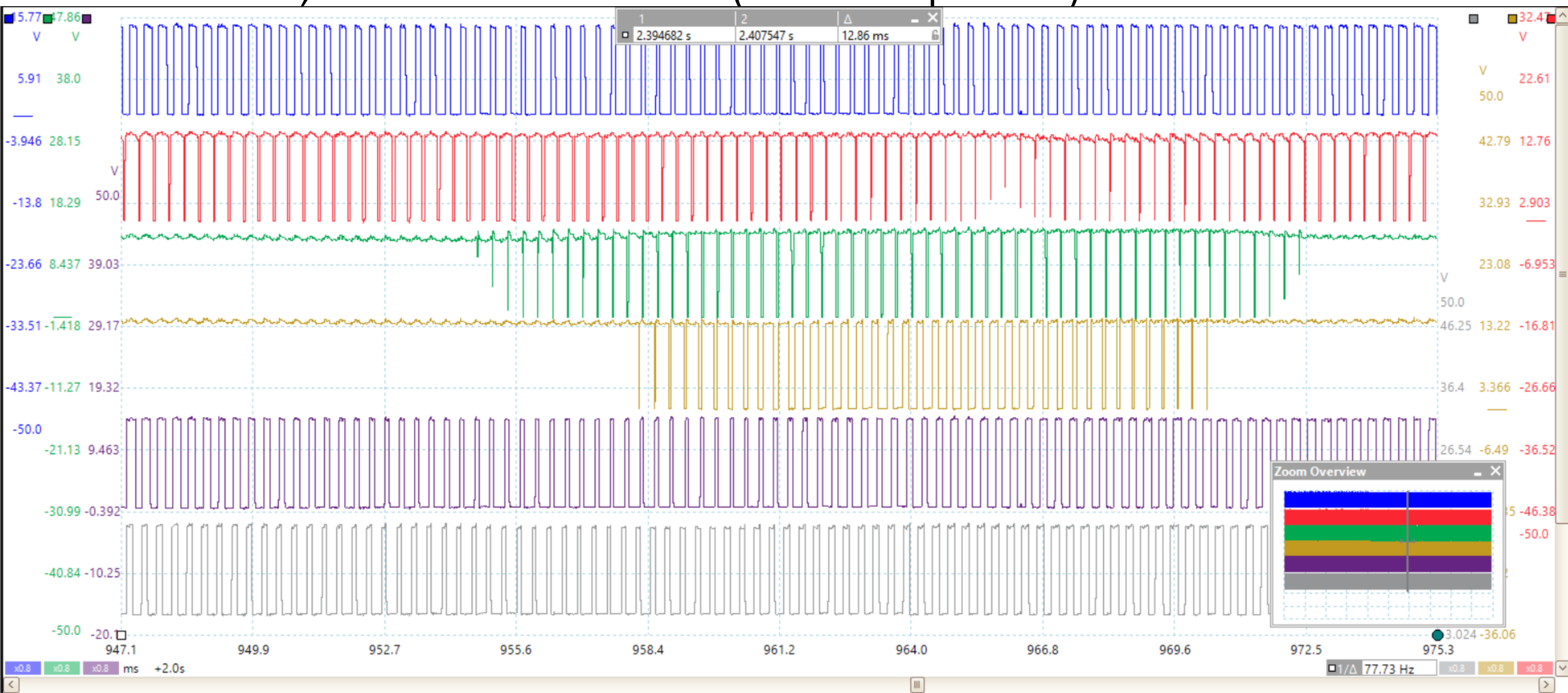
10L Solenoid Control – Electrical 5-6 shift

C modulates OFF (torq phase), D modulates ON (torq phase)

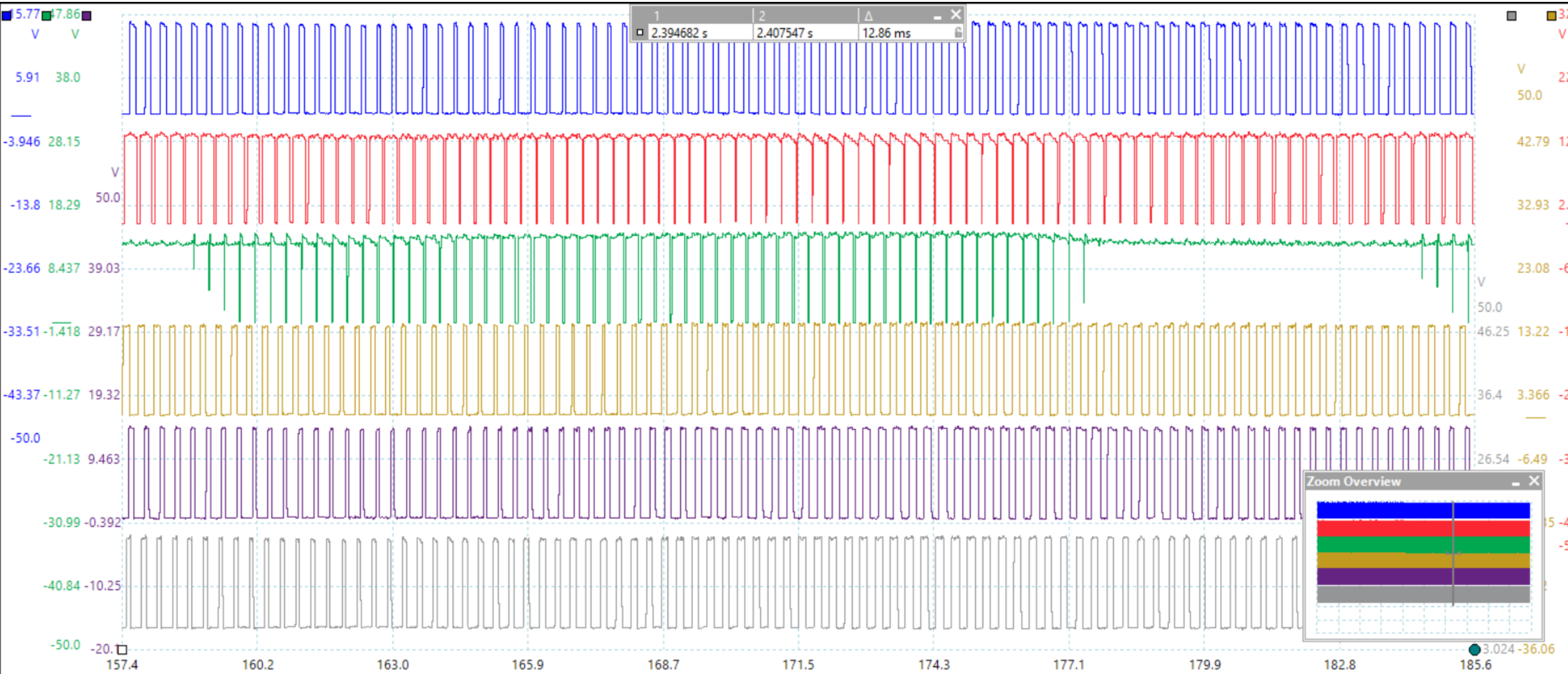


10L Solenoid Control – Electrical 5-6 shift

C is OFF, D modulates ON (Inertial phase)



10L Solenoid Control – Electrical 5-6 shift final



Knowing how precise the
electronic control is.....

Keep in mind clutch clearance, leaks, pressures, bore wear

Clutch Clearance

- Essential
 - 6L80 Example
 - ~0.025" window
 - Five snap rings available
 - ~0.010 difference

3-5 Reverse Clutch

Clutch Pack Travel Specification – 1.21–1.79 mm (0.048–0.070 in)		
Retaining Ring Thickness		O.D. Color
Metric	English	
Note: After measuring clutch pack travel, determine if the measurement is within the specification. If the measurement is not within the specification, measure the thickness of the existing retaining ring, and then choose a thicker or thinner retaining ring that will bring the measurement within specification.		
1.61–1.71 mm	0.063–0.067 in	Gray
1.88–1.98 mm	0.074–0.078 in	Light Green
2.15–2.25 mm	0.085–0.089 in	Yellow
2.42–2.52 mm	0.095–0.099 in	None
2.69–2.79 mm	0.106–0.110 in	Purple

1-2-3-4 Clutch

Clutch Pack Travel Specification – 1.53–1.99 mm (0.060–0.078 in)		
Retaining Ring Thickness		O.D. Color
Metric	English	
Note: After measuring clutch pack travel, determine if the measurement is within the specification. If the measurement is not within the specification, measure the thickness of the existing retaining ring, and then choose a thicker or thinner retaining ring that will bring the measurement within specification.		
2.42–2.52 mm	0.095–0.099 in	None
2.69–2.79 mm	0.106–0.110 in	Purple
2.96–3.06 mm	0.117–0.120 in	Light Blue
3.23–3.33 mm	0.127–0.131 in	Orange
3.50–3.60 mm	0.138–0.142 in	White

Clutch Clearance – 10R example

Clutch	Specifications	
A clutch	0.029–0.048 in (.73–1.23 mm)	5 plates, ~0.008” variation
B clutch	0.052–0.069 in (1.31–1.74 mm)	6 snap rings, 0.012” variation
C clutch	0.062–0.074 in (1.57–1.87 mm)	5 snap rings, 0.008” variation
D clutch	0.069–0.081 in (1.75–2.05 mm)	6 snap rings, 0.008” variation
E clutch	0.044–0.068 in (1.12–1.72 mm)	6 plates, ~0.004” - 0.008” variation
F clutch	0.048–0.060 in (1.22–1.52 mm)	6 snap rings, 0.008” variation

- 0.012” – 0.024” window of clutch clearance between all clutches

Air Purge

Example – 6L80

Line pressure
265psi, 3/5/R
pressure pulses to
about 35 psi for ¼
second intervals

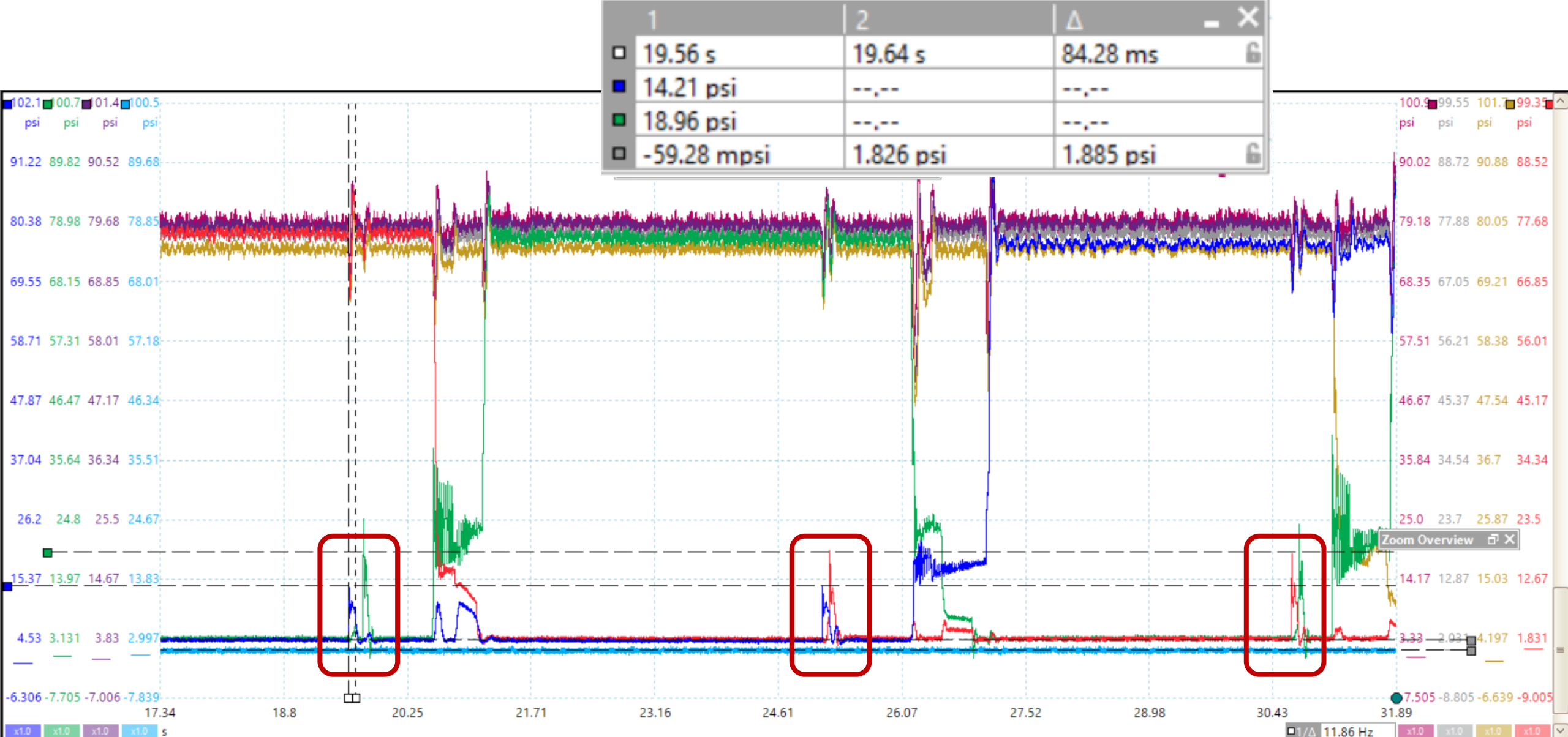
Single 456 pulse to
about 31 psi



Air Purge Example – 10L80



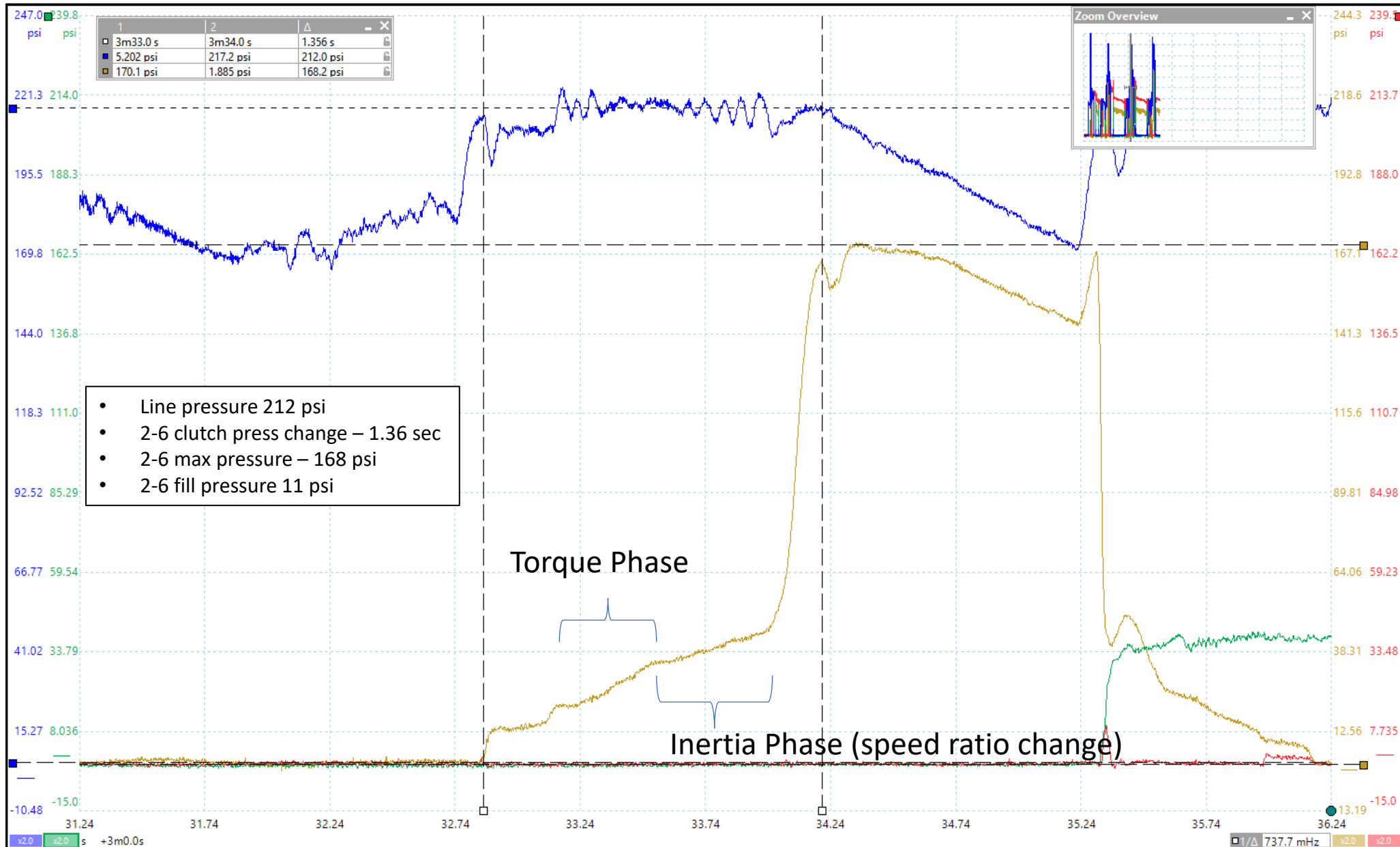
Air Purge Example – 10L80



Without pressure taps, what can we see?

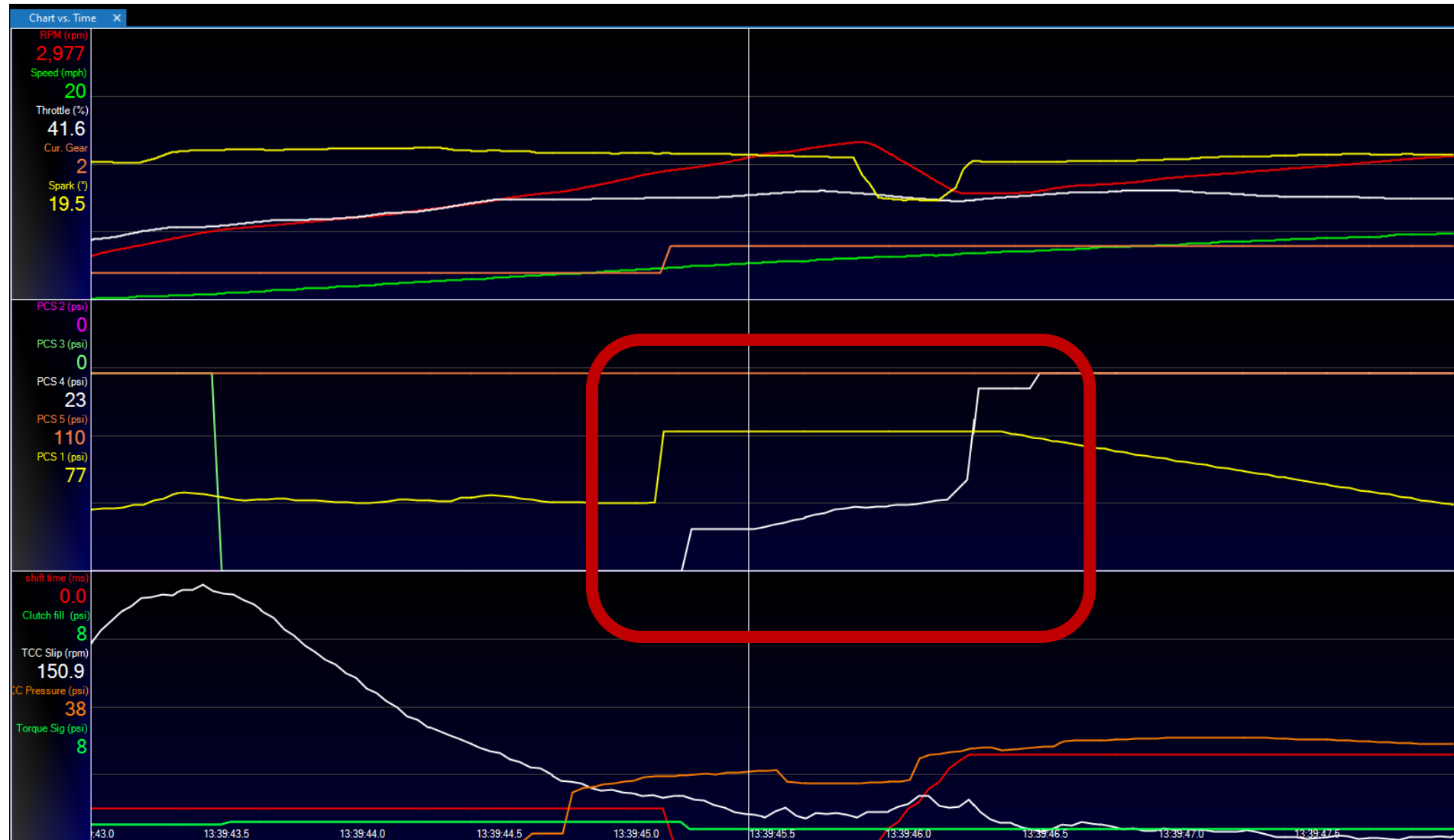
PCS pressure on scan tool shows computer logic pretty accurately

Baseline 1-2 shift 40% throttle



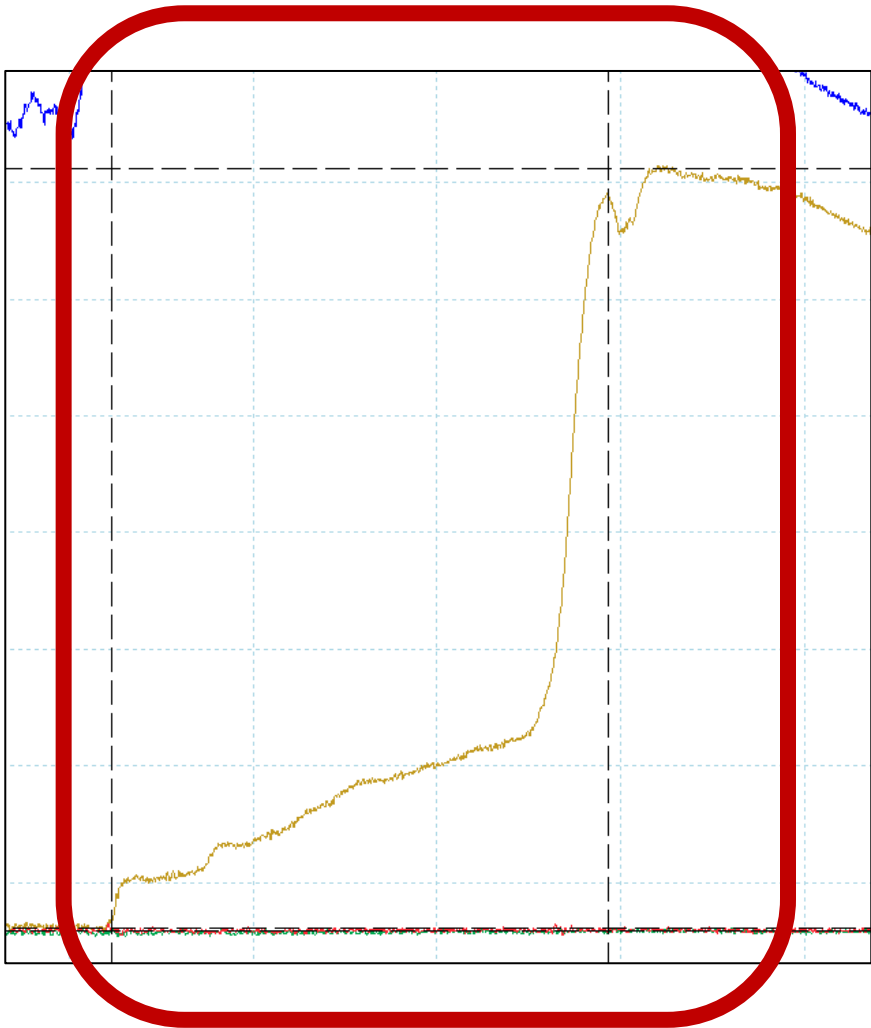
Baseline 1-2 shift 40% throttle

The solenoids as graphed on a scan tool matches the pressure curves pretty close. It's not actual clutch pressure, but the shape of the pressure curve is spot on.

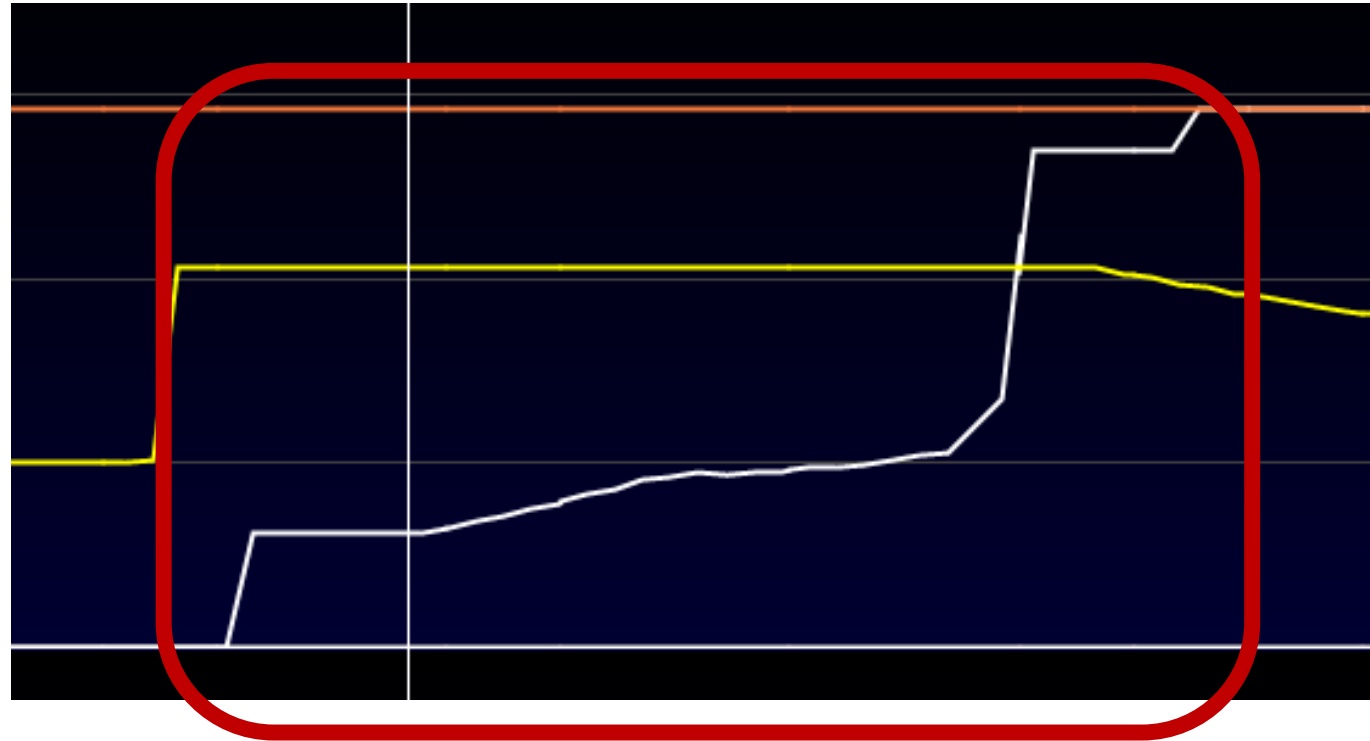


Baseline 1-2 shift 40% throttle

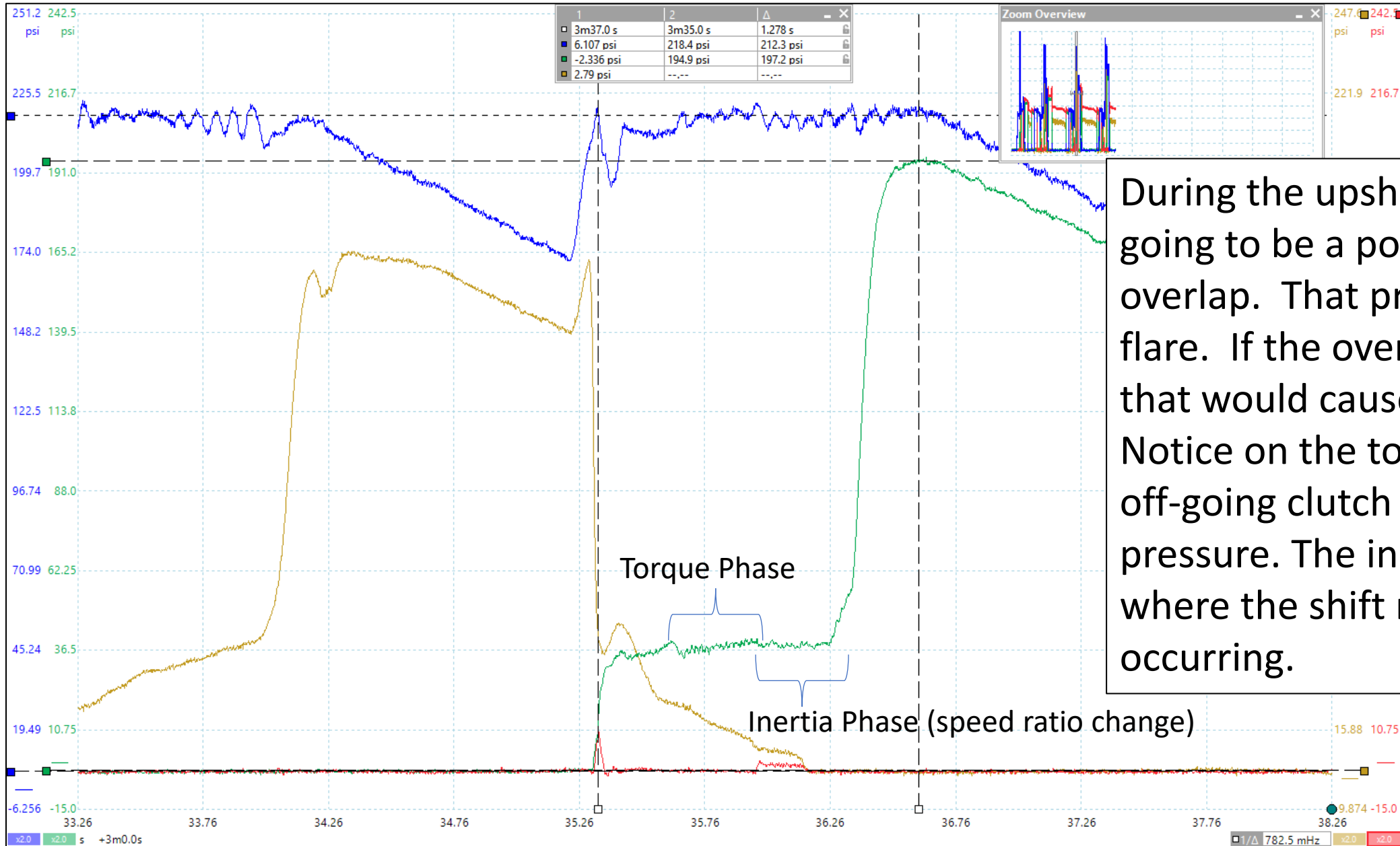
Actual Pressure



Solenoid command amperage

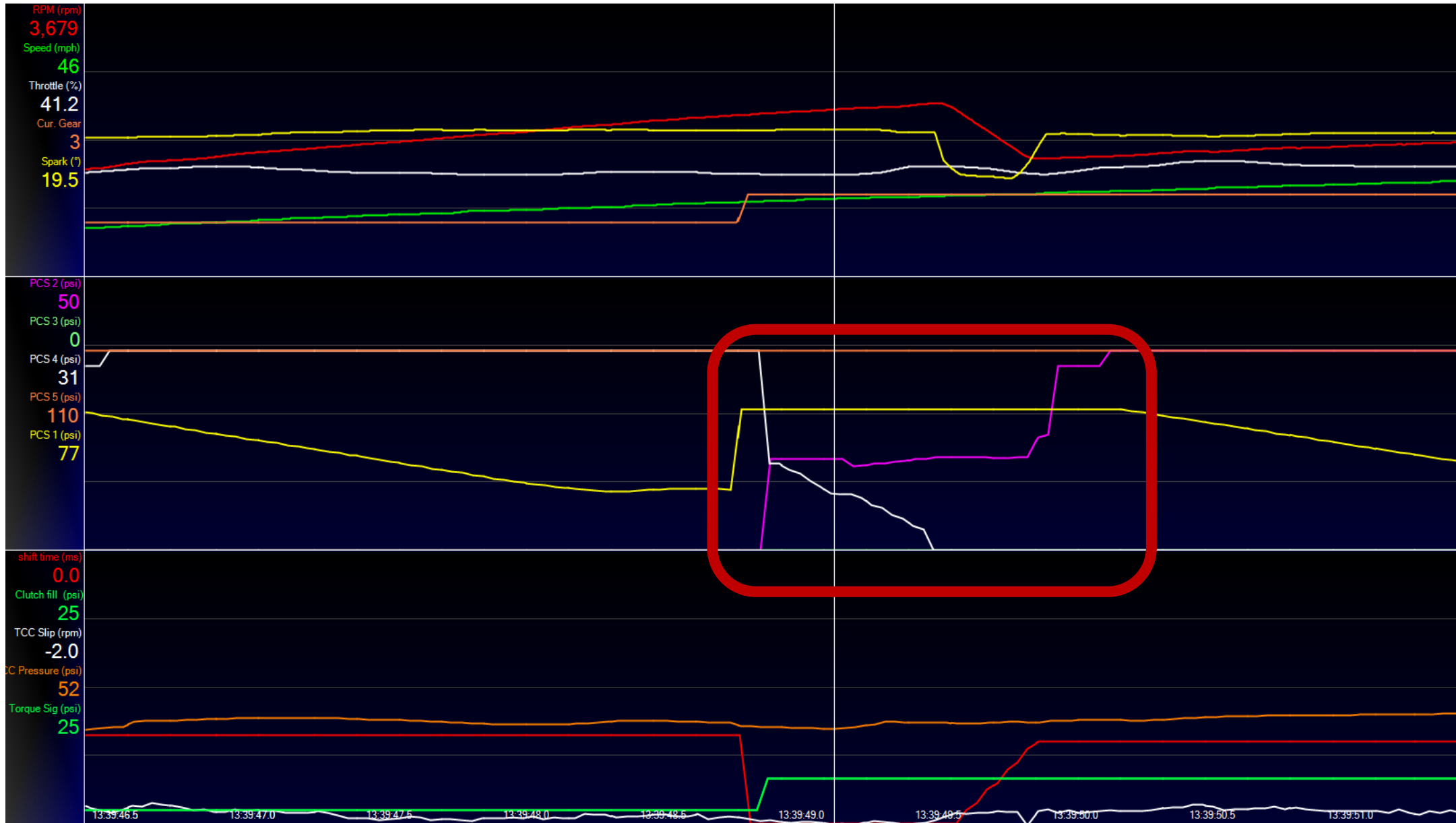


Baseline 2-3 shift 40% throttle

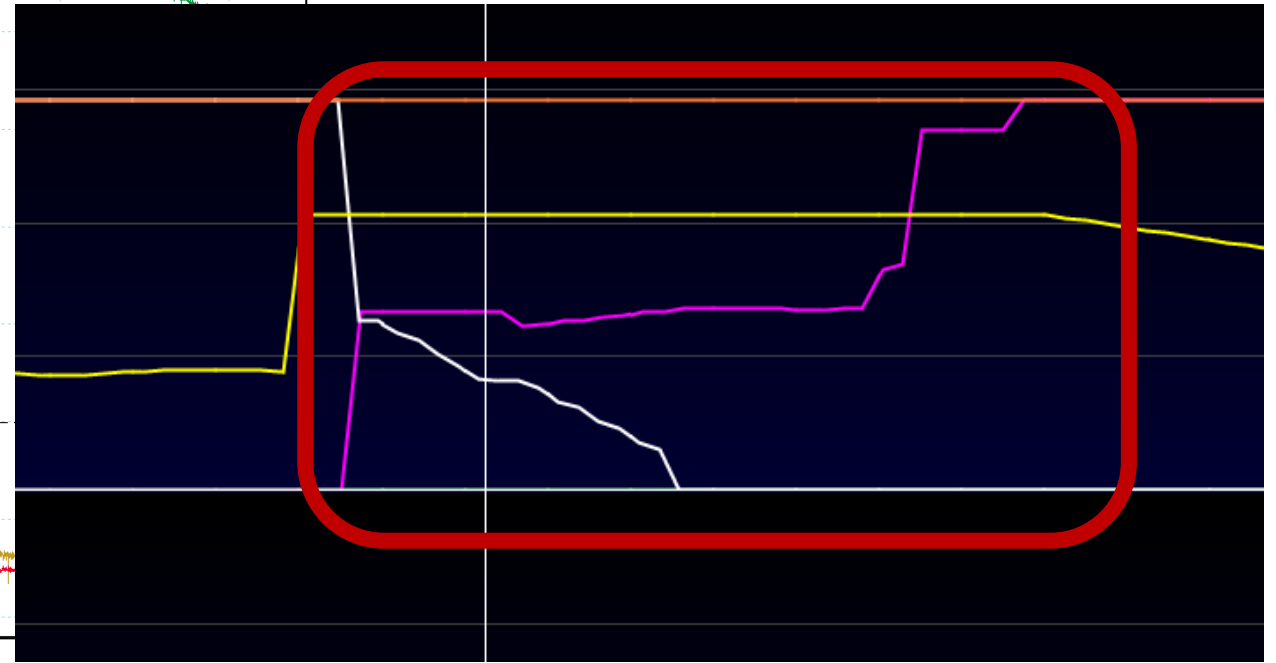
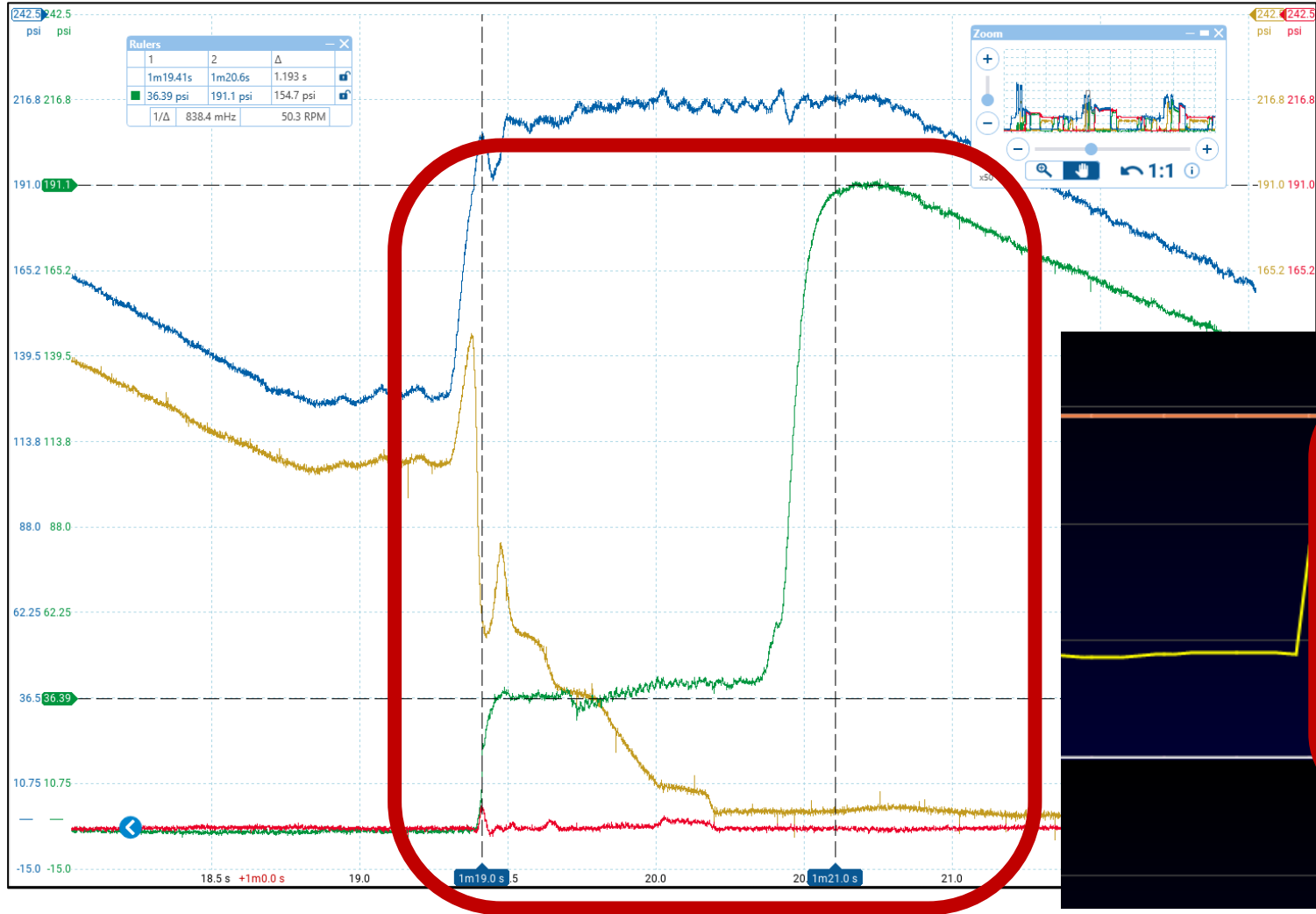


During the upshift, there's going to be a portion of overlap. That prevents a shift flare. If the overlap is too long, that would cause a shift bind. Notice on the torque phase, the off-going clutch is dropping pressure. The inertia phase is where the shift ratio change is occurring.

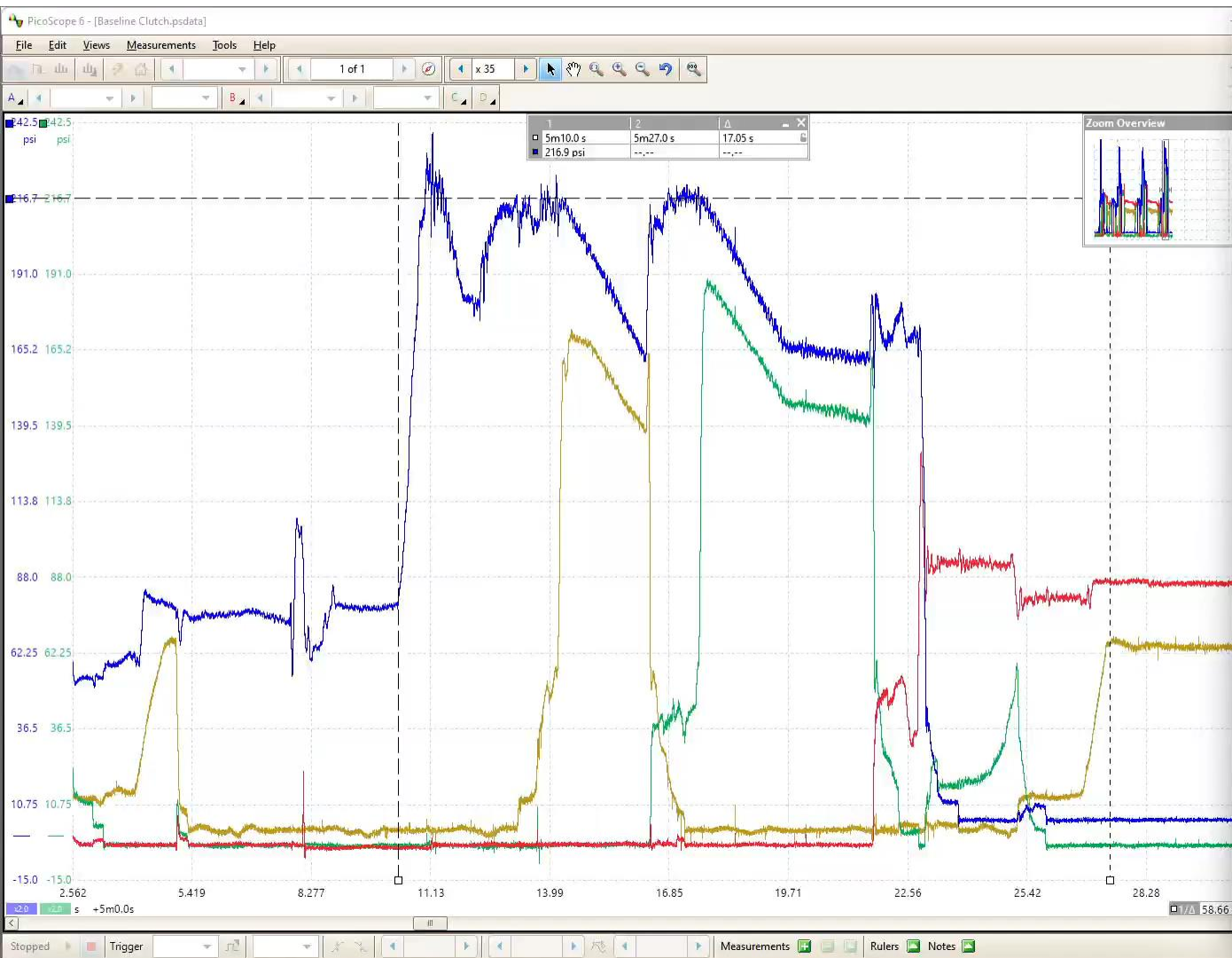
Baseline 2-3 shift 40% throttle



Baseline 2-3 shift 40% throttle



Baseline with WOT



OBS 29.1.2 - Profile: Untitled - Scenes: full screen capture

File Edit View Docks Profile Scene Collection Tools Help

Scene

Display Capture

Start Streaming

Start Recording

Start Virtual Camera

Studio Mode

Settings

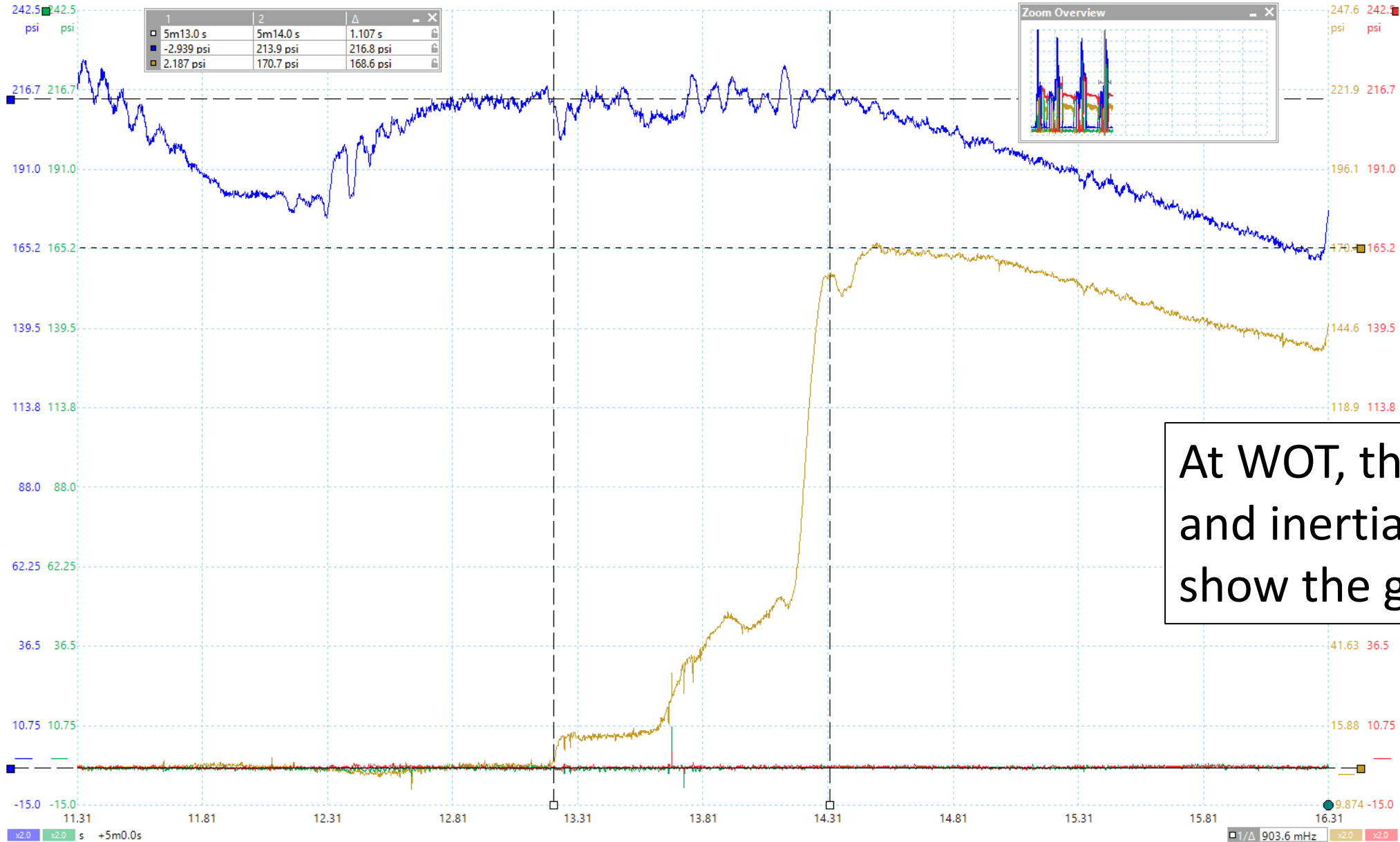
Exit

LIVE: 00:00:00 REC: 00:00:00 CPU: 0.2%, 30.00 fps

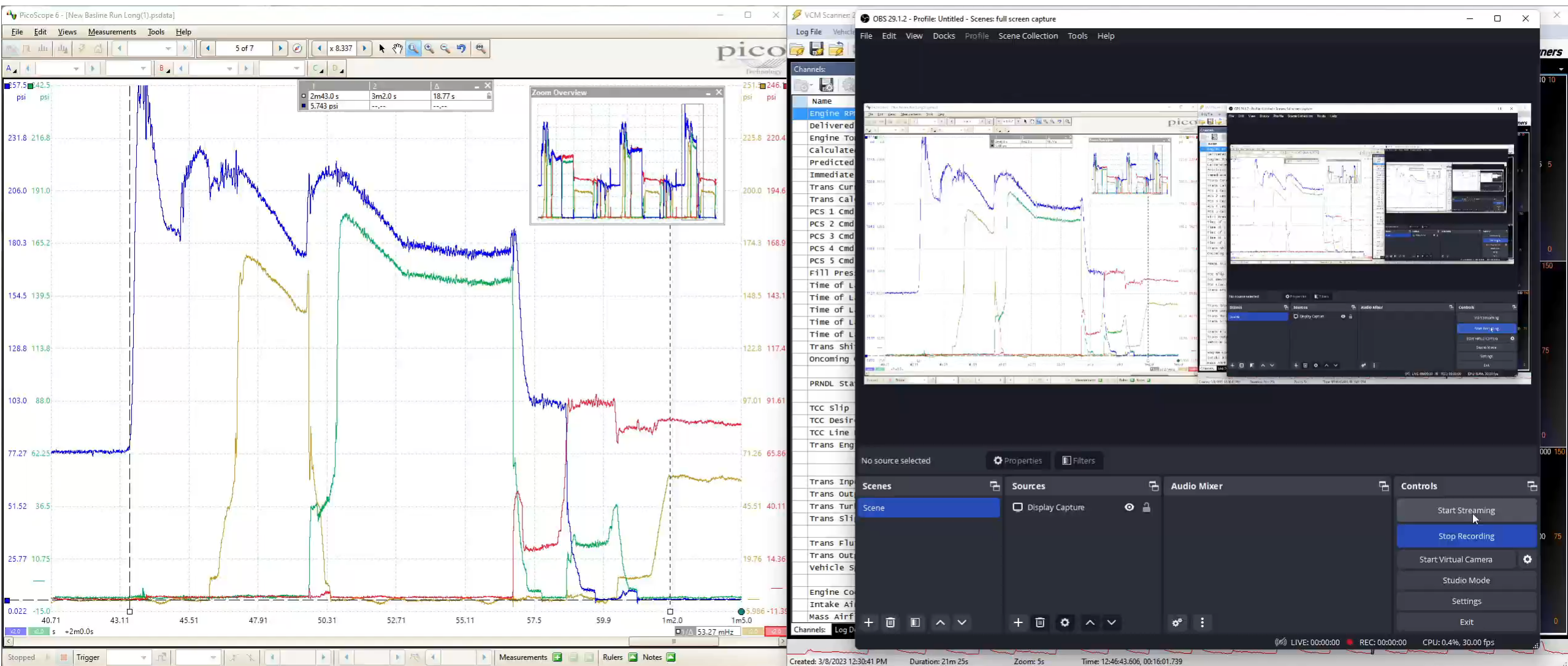
Created: 5/10/2023 1:53:27 PM Duration: 5m 32s Zoom: 10s Time: 01:58:38.662, 00:05:02.012

Detailed description: This is a screenshot of the OBS Studio 29.1.2 interface. The main window shows a 'Full Screen Capture' of the PicoScope 6 software. The OBS interface includes a menu bar at the top, a 'Scenes' dock on the left, and a 'Sources' dock in the center. The 'Sources' dock shows 'Display Capture' selected. On the right side, there is a 'Controls' dock with buttons for 'Start Streaming', 'Start Recording', 'Start Virtual Camera', 'Studio Mode', 'Settings', and 'Exit'. The 'Start Recording' button is highlighted. At the bottom of the OBS window, there is a status bar showing 'LIVE: 00:00:00', 'REC: 00:00:00', and 'CPU: 0.2%, 30.00 fps'. Below the OBS window, there is a system tray area with a clock and other system icons.

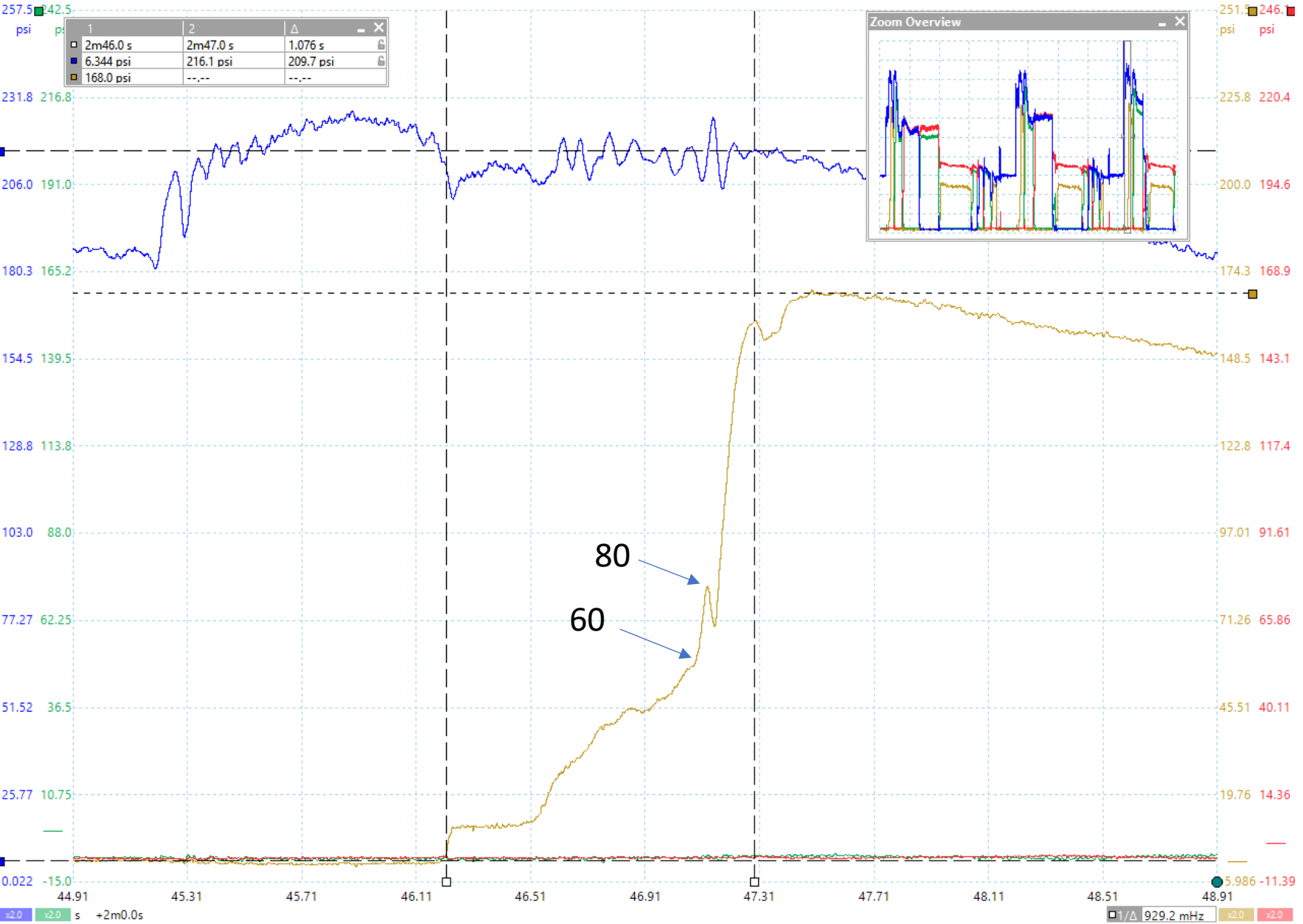
Baseline 1-2 WOT



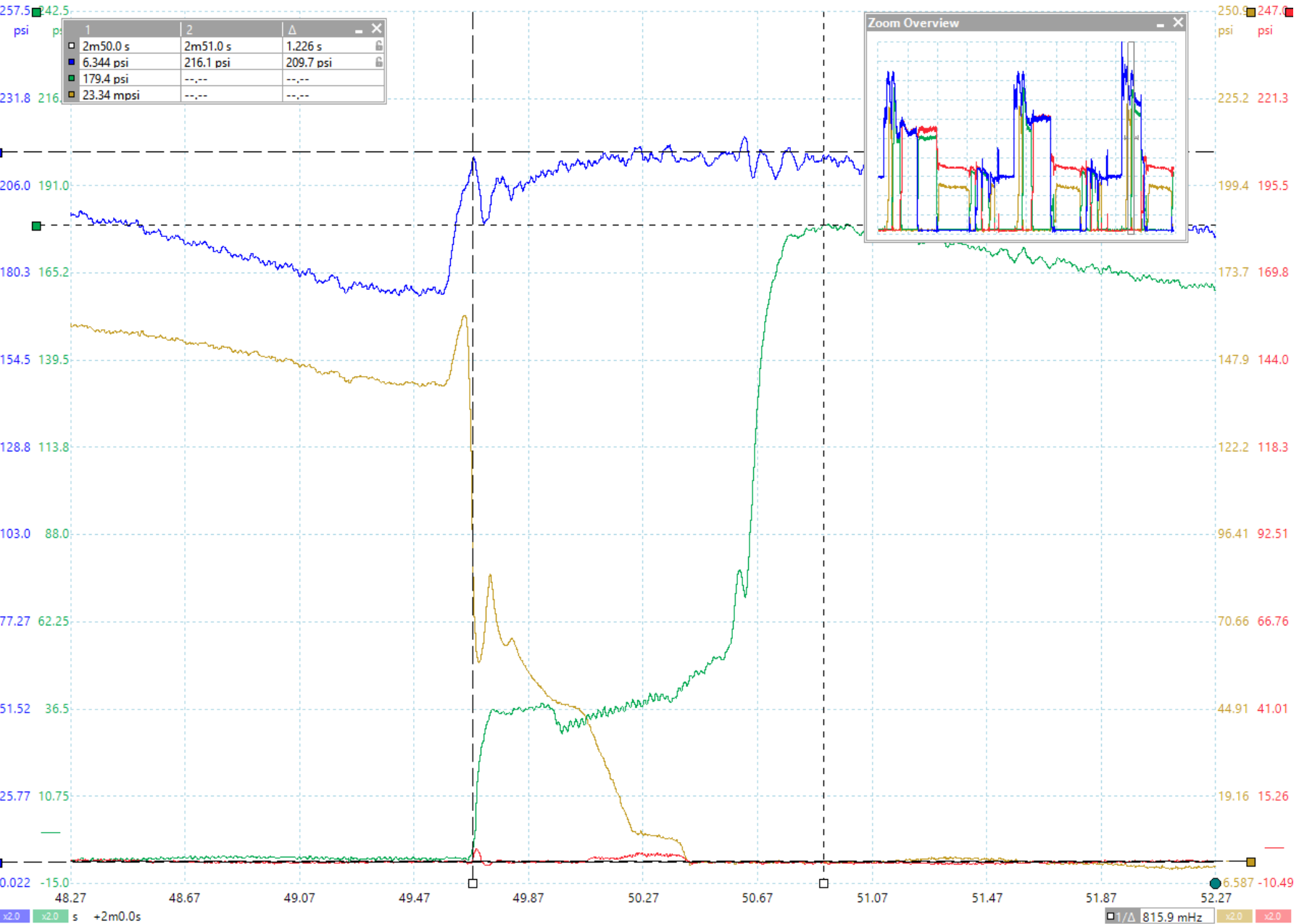
Alt Baseline with WOT



Alt Baseline 1-2 WOT



Alt Baseline 2-3 shift WOT



Torque Management

- Much lower engine torque during shift
 - Timing Reduction
 - Throttle Reduction
- Only during Inertia Phase

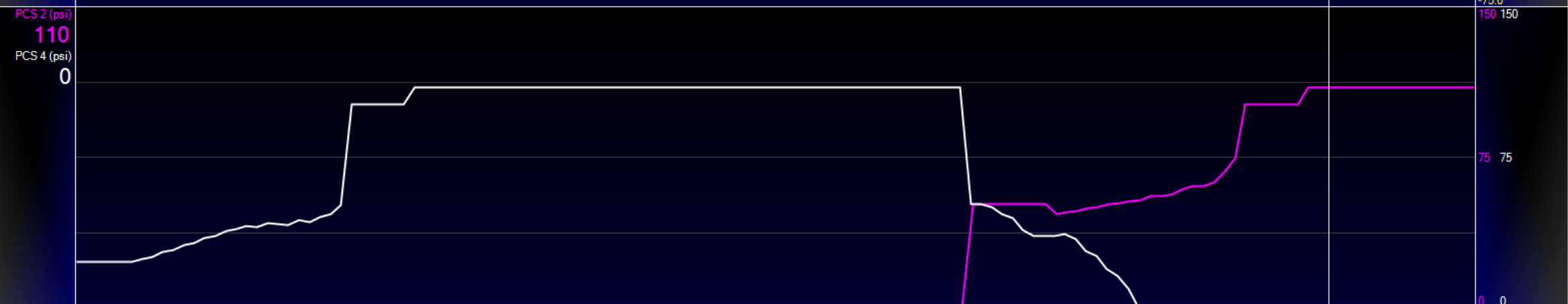
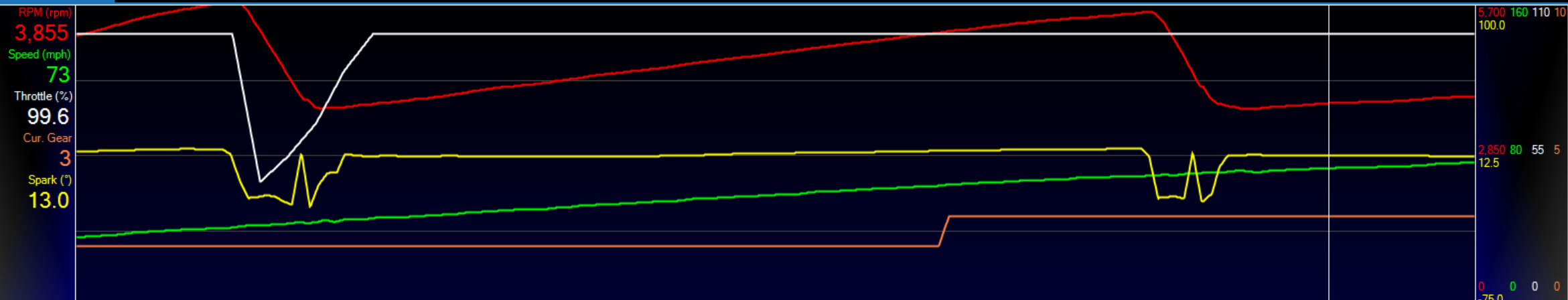
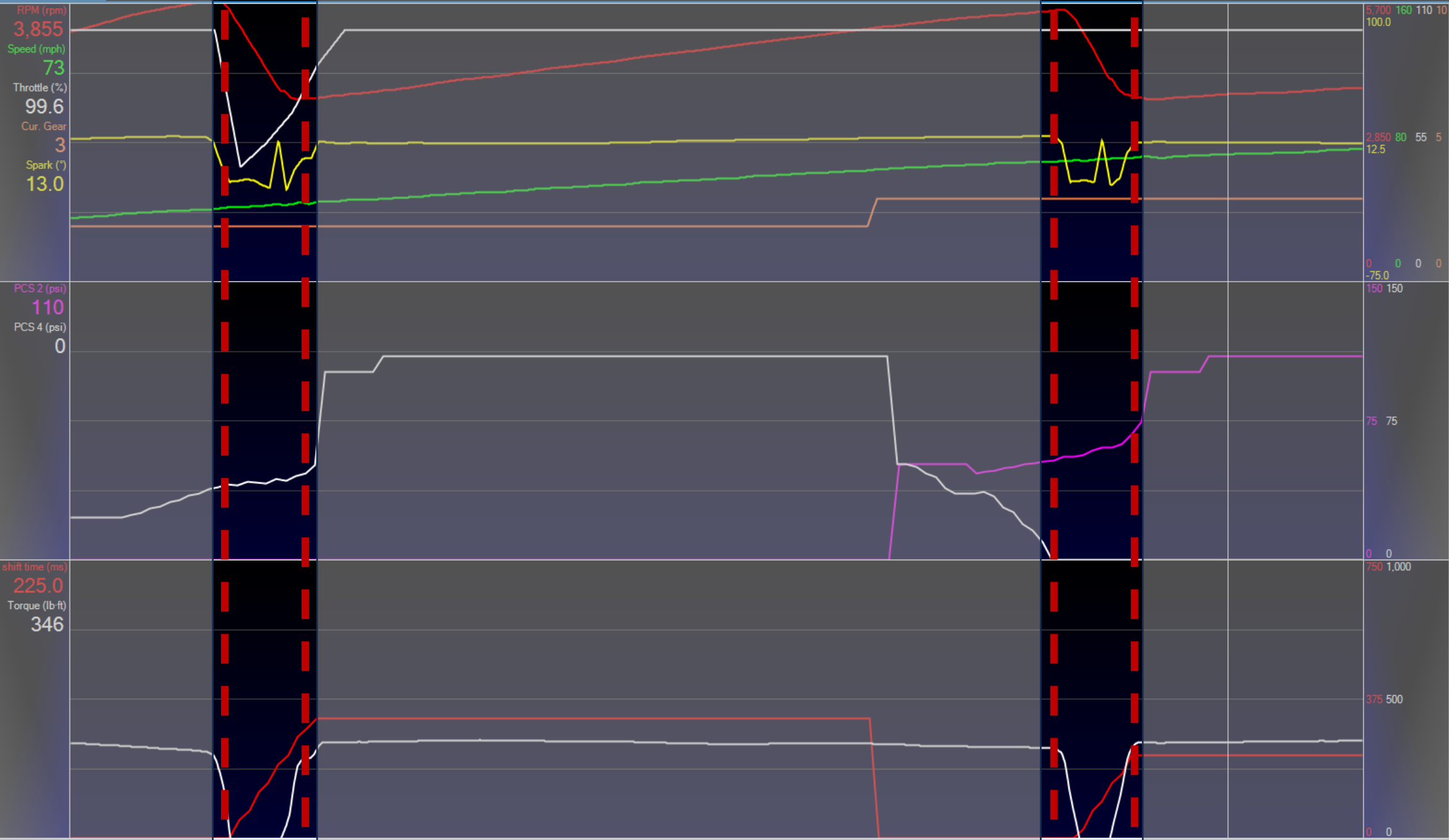


Chart vs. Time



Speed (mph)
50
Cur. Gear
3
RPM (rpm)
4,492

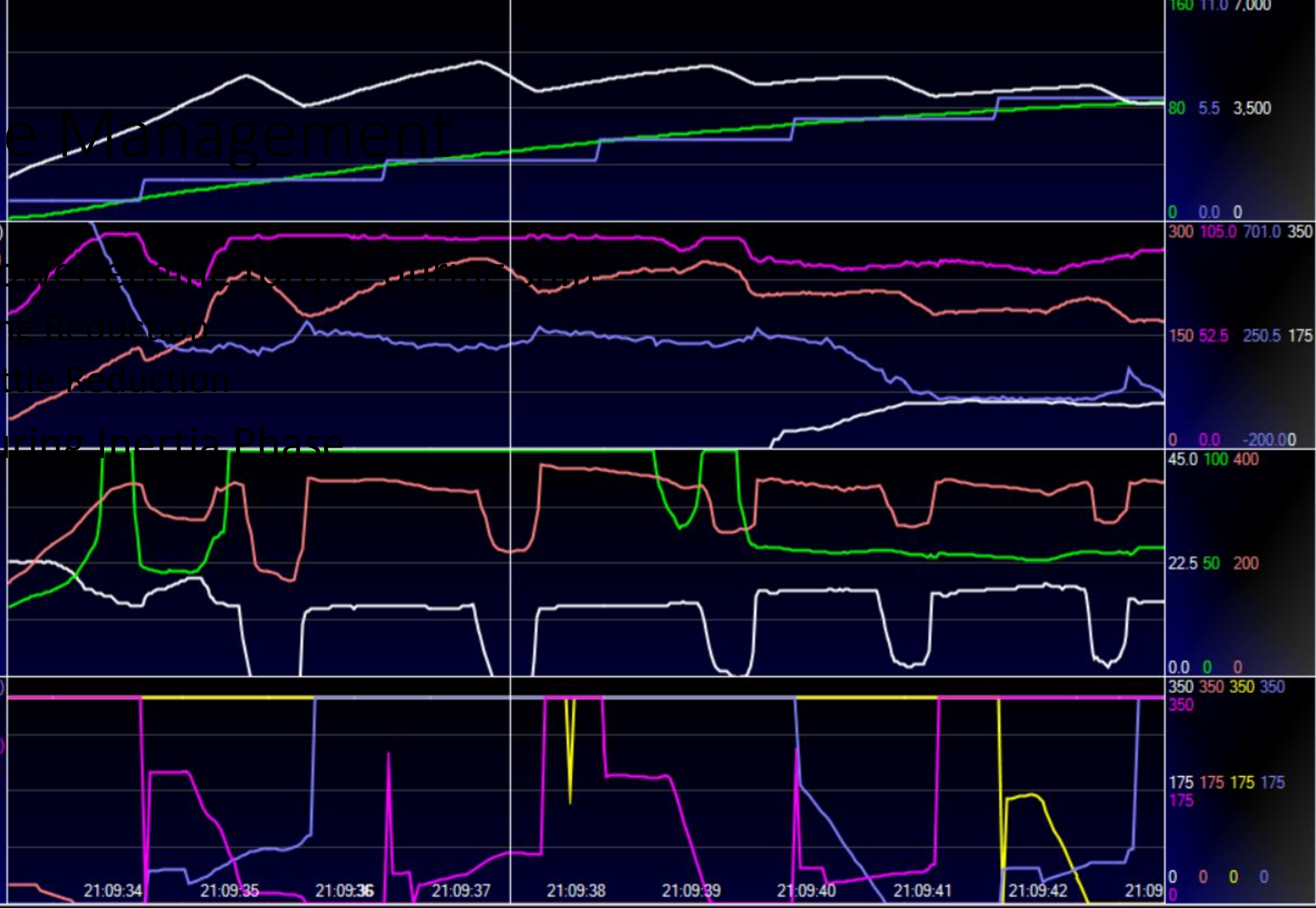
MAF (g/s) **237.08**
MAP (kPa) **98.0**
TCC slip (rpm) **219.3**

Spark (°) **-2.5**
Throttle (%) **100.0**
trans eng tq (lb-ft) **222**

pcs 1 (psi) **319**
pcs 2 (psi) **0**
pcs 3 (psi) **319**
pcs 4 (psi) **319**
pcs 5 (psi) **80**

Torque Management

- Much lower engine torque within shift
- Timing Reduction
- Throttle Reduction
- Only during Inertia Phase



Speed (mph)

50

Cur. Gear

3

RPM (rpm)

4,492

MAF (g/s) TCC Pressure (psi)

237.08

MAP (kPa)

98.0

TCC slip (rpm)

219.3

Spark (°)

-2.5

Throttle (%)

100.0

trans eng tq (lb-ft)

222

pcs 1 (psi)

319

pcs 2 (psi)

0

pcs 3 (psi)

319

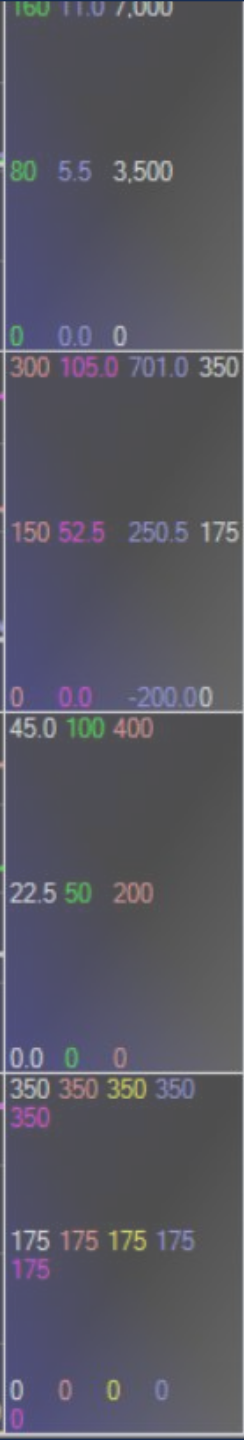
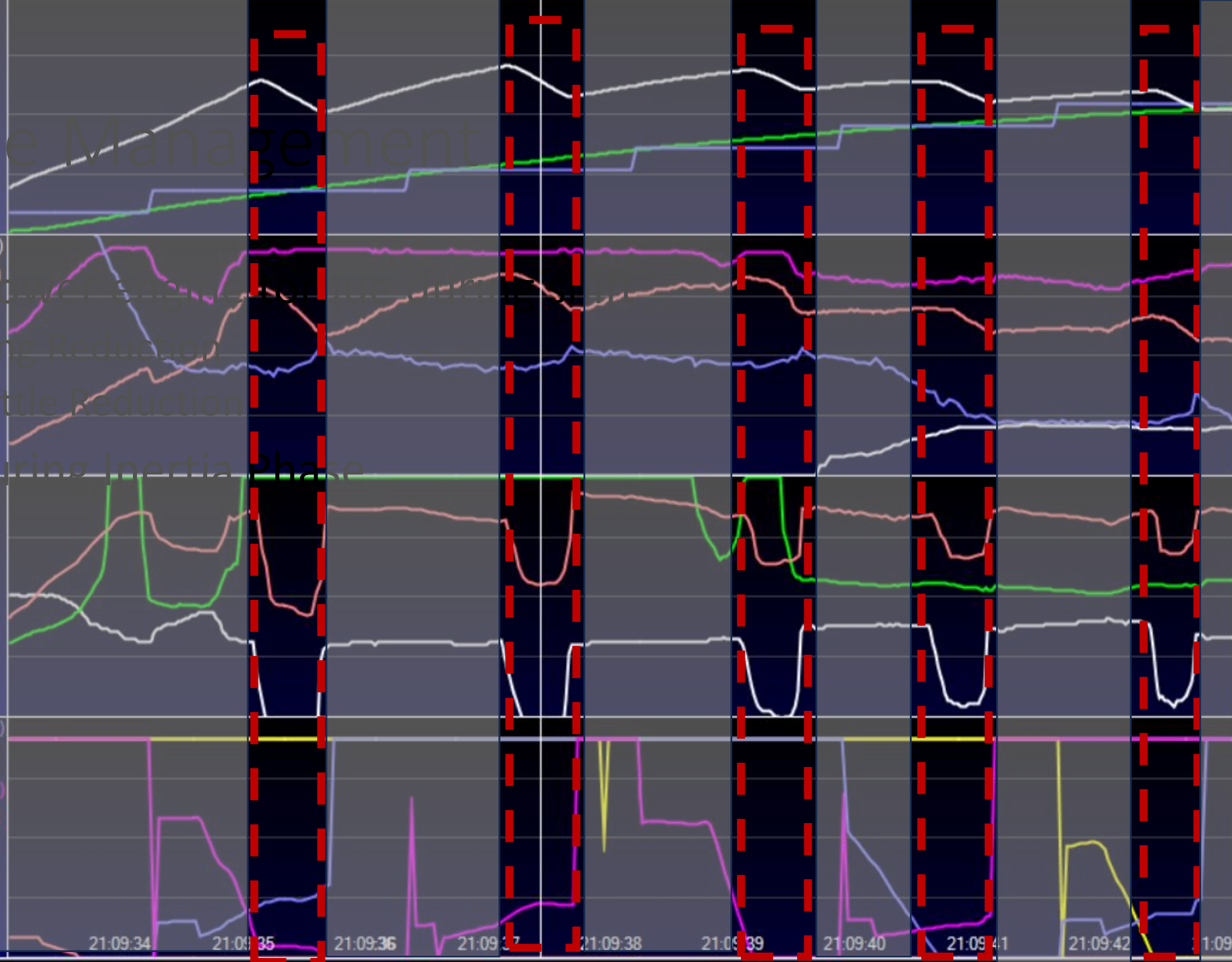
Torque Management

• High Power engine

• Timing Reduction

• Throttle Reduction

• Only during Inertia Phase



Conclusion

- Impressive how the electronics have such an influence over the shift quality and durability of a modern transmission.
 - ECM inputs to provide information to a transmission control module
 - TCM uses that information to control clutch pressures, timing, and line pressure
 - Offgoing clutch is controlled precisely through PWM solenoid control pressure to a clutch regulator valve, which controls pressure to the clutches
 - Oncoming clutch is controlled precisely through a TCM controlling a solenoid, which controls pressure to a clutch regulator valve, which controls the pressure in the clutches
 - These all have to work consistently through various temperatures and adapt for wear over time

GM/Ford 10-speed



Electronic Operation – TCM



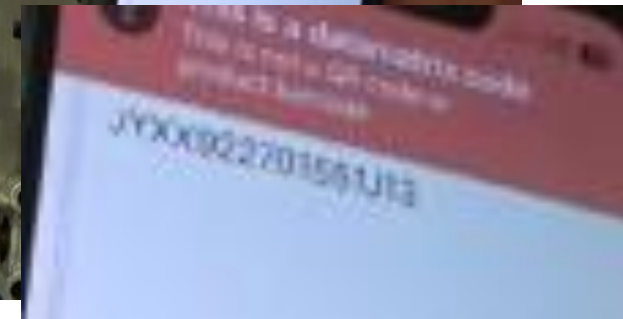
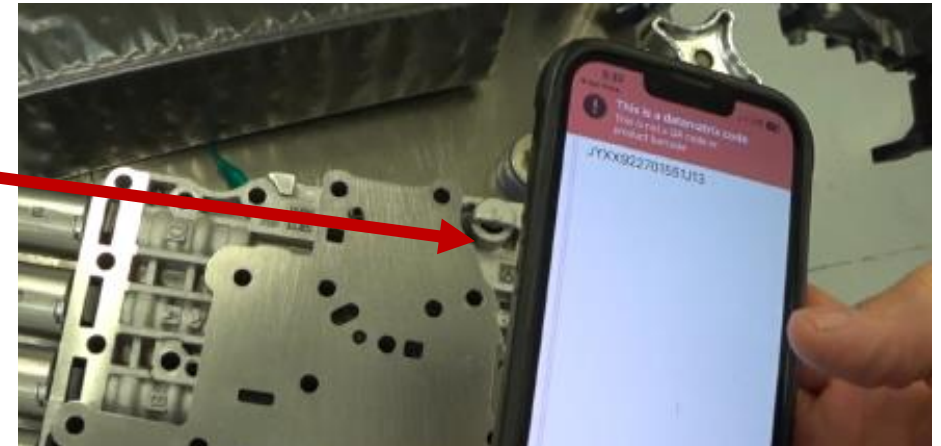
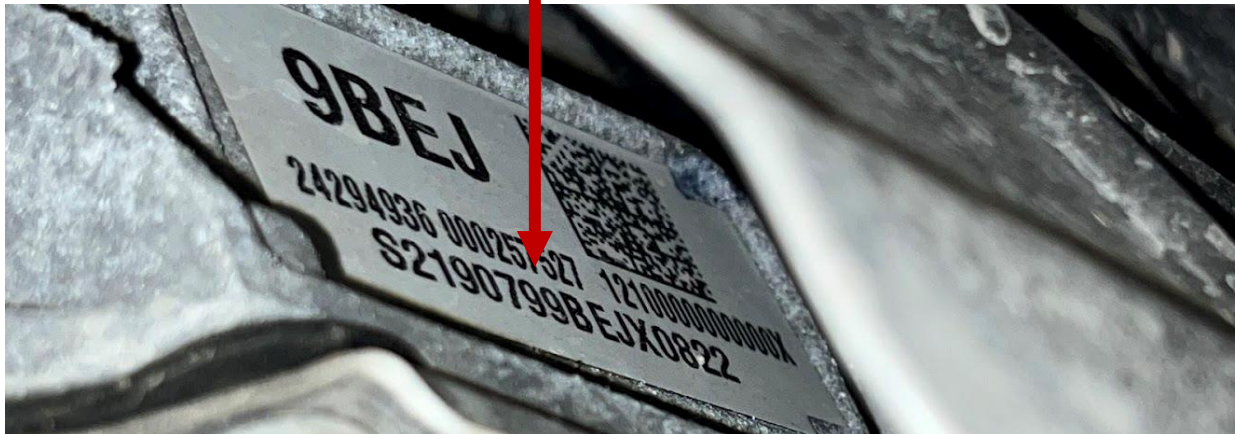
- **External TCM –**
 - GM Trucks are behind the left front wheel well behind the PCM
 - Ford combines TCM in the PCM
- **Check for updates to the programming!**

Identification

- Ford
 - Solenoid Strategy
 - 13 digits
 - Solenoid Body ID (PUN)
 - 12 digits

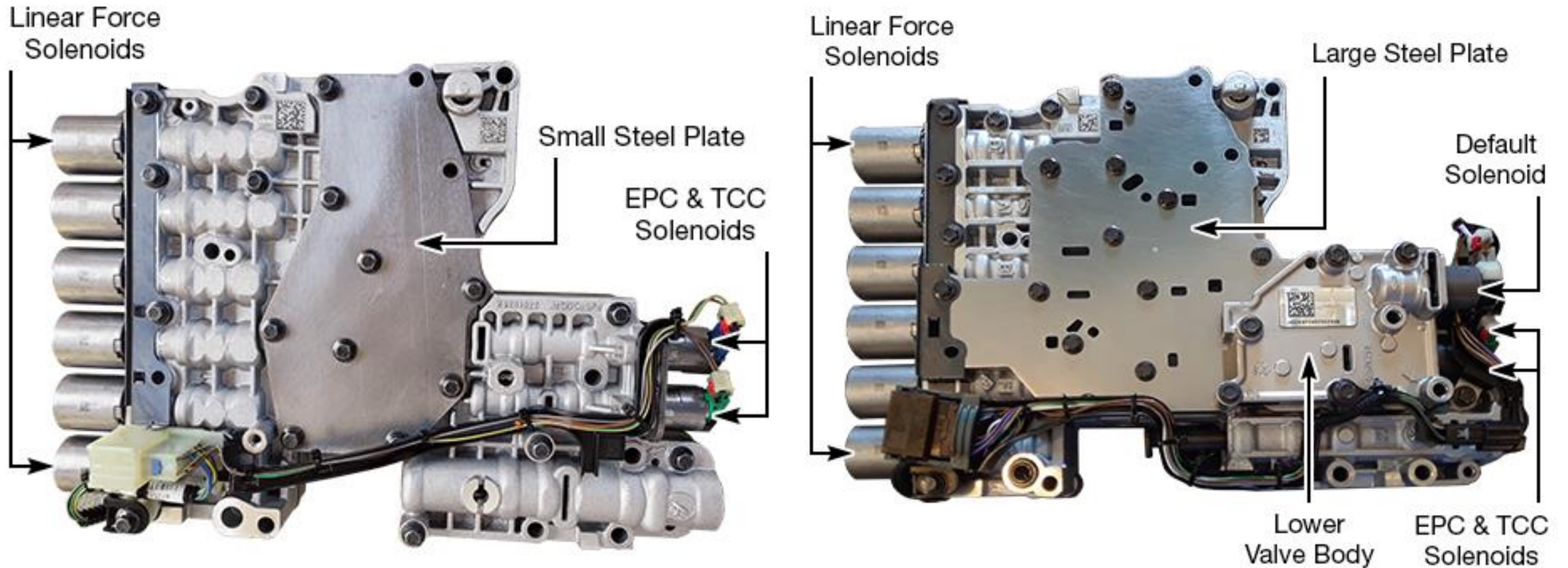


- GM
 - Part Unique Number (PUN)
 - Transmission Unique Number (TUN)



VB generations

- Gen 1 (Ford/GM) vs. Gen 2 (GM) (Image from Sonnax)



VB generations

Valve Body - Main Control & Servo's Back

Attach Illustration Print

Selected Parts

Control Assy - Transmission
 List Price: \$536.67
 Core: \$200.00
 From: 07/17/2017 To: 10/22/2020 ; 10 Speed Auto Transmission (10R80)
 Callout: 7A100

Ford
 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!

Price: **\$389.62**
 Qty Req: Add To Cart

[Show Other Parts In Illustration](#)

<input type="checkbox"/>	Part Number	Part Description	Brand	Promotion	Pricing	Req Qty	Availability
<input type="checkbox"/>	JL3Z7A100C	Control Assy - Transmission	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON...	List Price: \$536.67 Price: \$389.62 Core: \$200.00	<input type="text" value="1"/>	2

3079150A
07-2017
10R80
F0344710-03
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Electronic Operation – TCM

Home Vehicle ID Diagnostics Connected Vehicle TSB/GSB/SSM Workshop Wiring PC/ED Service Tips Owner Info
PDI SLTS

The information displayed on this screen is based on the last information Ford Motor Company received about this vehicle. It is possible that the vehicle has received an update which is not reflected here. A Ford diagnostic tool such as FDRS or IDS will need to be used to check the current software in the vehicle and apply software updates.



Acronym	Description	Update Available	Assembly Part No	Derived Assembly Part No.	Software Part No.	Last Updated
ABS	anti-lock brake system	●	NL34-2C219-CC	NL34-2C219-CB	NL34-2D053-CA	03 April 2023 18:56
ACM	audio front control module	●	ML3T-18K810-CDH	ML3T-18K810-CDH	JX7T-14C302-BZ	04 December 2023 19:36
APIM	Accessory Protocol Interface Module		MU5T-14G670-PYG	DSPU5T-14G670-CC	PU5T-14G676-CC	12 December 2023 20:23
ATCM	all terrain control module		NL3T-14G066-BB	NL3T-14G066-BB	NL3T-14D024-AB	03 April 2023 18:56
BCM	body control module	●	MU5T-14B476-KAH	MU5T-14B476-KAH	MU5T-14C184-AAH	03 April 2023 18:56
BCMC	body control module C	●	ML3T-14D068-SD	ML3T-14D068-SD	MU5T-14G630-DD	03 April 2023 18:56
DDM	driver door module	●	MU5T-14B531-BN	MU5T-14B531-BN	MU5T-14C064-BN	03 April 2023 18:56
GSM	gear shift module		ML3P-7P427-AN	ML3P-7P427-AN	ML3P-7P470-AK	03 April 2023 18:56
GWM	gateway module A		MU5T-14G650-GAF	DSMU5T-14G650-NA	ML3T-14H021-PAF	24 July 2024 03:13
HVAC	heating, ventilation and air conditioning	●	NL3T-18C612-RB	NL3T-18C612-RB	NL3T-18D619-BB	03 April 2023 18:56
IPC	instrument panel cluster		NL3T-10849-DCF	DSNL3T-1A292-DAA	NL3T-14C026-DAE	03 April 2023 18:56
IPMA	image processing module A	●	ML3T-14G647-FBA	ML3T-14G647-FV	ML3T-14H102-ABT	02 May 2024 10:22
PCM	powertrain control module	●	ML3A-12A650-GKC	NL3A-12A650-DGC	NL3A-14C204-DGC	03 April 2023 18:56
PDM	passenger door module	●	MU5T-14B533-BN	MU5T-14B533-BN	MU5T-14C108-BN	03 April 2023 18:56
PSCM	power steering control module	●	ML34-3F964-BR	ML34-3F964-BR	ML3V-14D003-BC	03 April 2023 18:56
RCM	restraints control module		ML3T-14B321-YD	ML3T-14B321-YD	ML3T-14C028-CA	03 April 2023 18:56
RTM	radio transceiver module		ML3T-15K619-JA	ML3T-15K619-JA	ML3T-14G090-CA	03 April 2023 18:56
SCCM	steering column control module	●	ML3T-3F944-AJ	ML3T-3F944-AJ	ML3T-14C579-AH	03 April 2023 18:56
SODL	side obstacle detection control module LH		ML3T-14H031-BH	ML3T-14H031-BH	ML3T-14H094-BH	03 April 2023 18:56
SODR	side obstacle detection control module RH		ML3T-14H031-AH	ML3T-14H031-AH	ML3T-14H094-AH	03 April 2023 18:56
TCCM	transfer case control module		ML3A-7H417-PA	NL3A-7H417-HA	NL3A-14C366-HA	03 April 2023 18:56
TCU	telematic control unit module		MU5T-14H074-FLA	DSMU5T-14H074-ABR	SU5T-14H085-GE	04 March 2024 23:46
TRM	trailer module	●	ML3T-19J294-BB	ML3T-19J294-BB	ML3T-19J297-BB	03 April 2023 18:56

Electronic Operation – TCM

Module:

- 24047397 - Transmission
 - 24054717

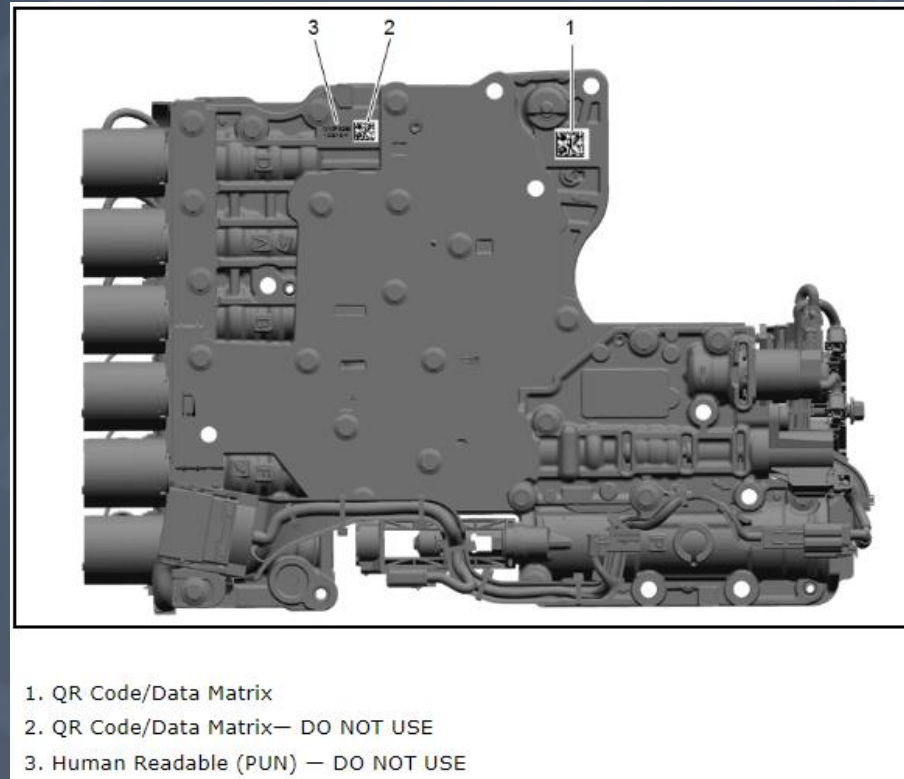
Part Number	CVN	Description
24054717	00003922	Transmission Update to address RC Cold Screen Blow Out
24047397	0000CABD	Transmission

Selected Options:

VIN:	3GCPYFED1NG191453
Controller:	K71 Transmission Control Module
Function:	Programming
Programming Type:	Normal
Transmission:	With 10 SPD Automatic Transmission (RPO MGM/MGU/MQB)

GM MCVM

- Solenoid characterization
 - Mechanical Characterization and Virtual Matching (MCVM)
 - Transmission Unique Number
 - Part Unique Number (scan QR Code)
 - Genealogy Tree
 - Process communicates to the cloud with the VIN to download the genealogy tree for the vehicle
 - Once the change is made, the genealogy tree updates in the cloud



GM MCV

Techline Connect 1.25.10 Production

SPS2

Welcome to Service Programming System 2

VIN: 1GCVYGET5KZ339216

Model: Silverado 1500 (New Model) - 4WD
Type: -
Make: Chevrolet
Year: 2019

Diagnostic Tool Ready!
J2534 Bosch;MDI;04.04;J2534-2:SN="22000578" CXN="USB";

Selected Programming Process: **Reprogram**
Reprogram
Replace and Reprogram

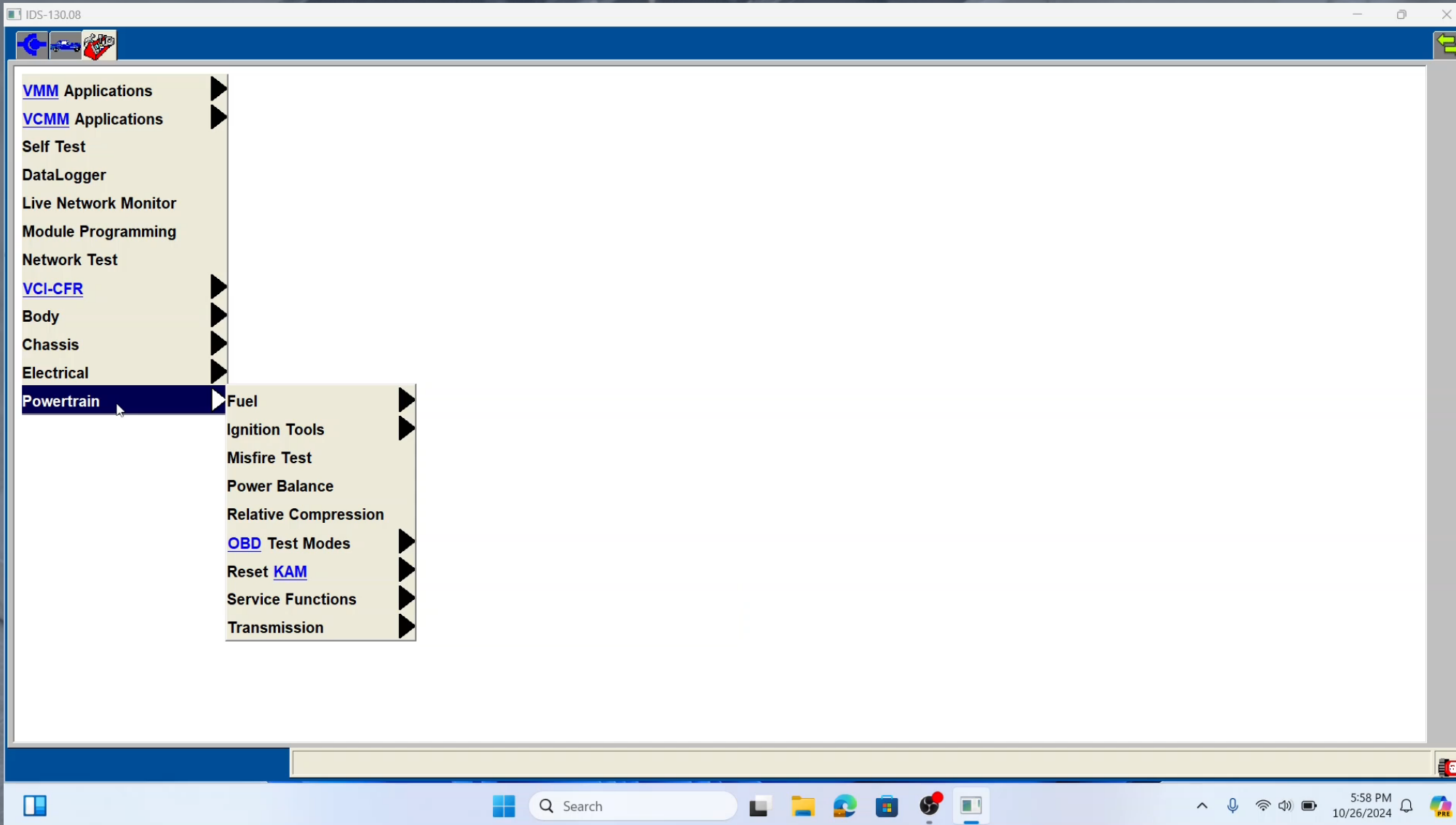
Auto Detect New Vehicle | Manually Enter Vehicle | Auto Detect Tool | Manually Select Tool

Java Version: 1.8.0_92 | SPS2 Version: 2.22.18.5369 | Windows Version: Windows 10

Print | Settings | Next

62°F Sunny | Search | 5:36 PM 10/26/2024

Ford Solenoid Strategy and Solenoid Body ID

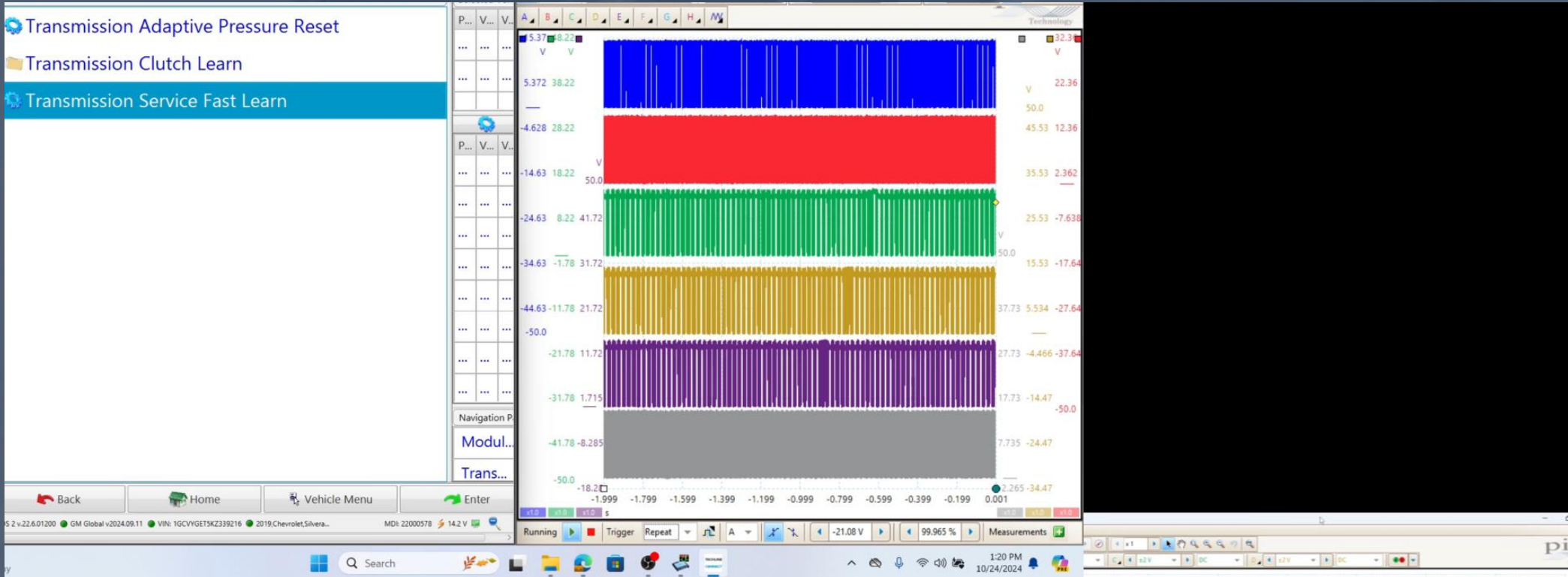


Solenoid Banding

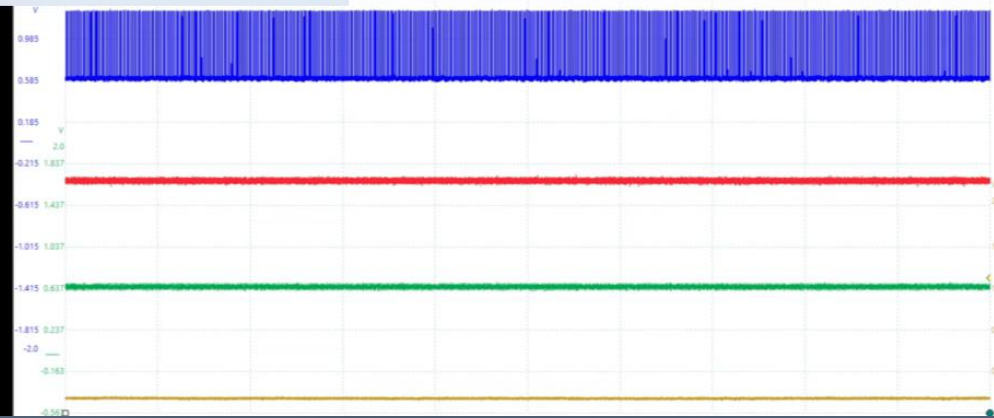
- Not all solenoids are created equal



10L/10R Scan Tool Adaptives



00:00:00



Programming

NOTE: *Perform the adaptive learning drive cycle on a level road surface.*

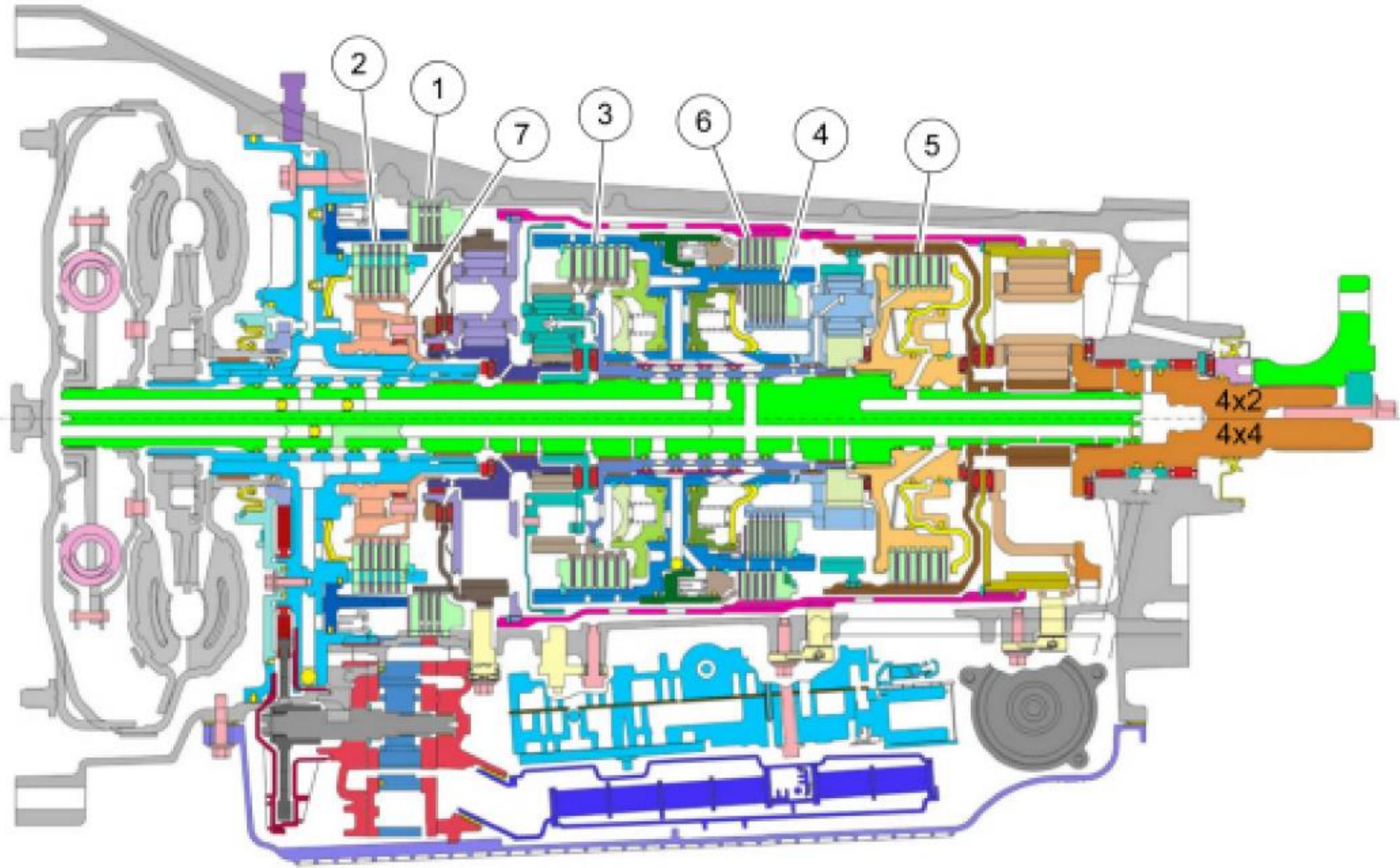
1. Using the scan tool, clear the DTCs (Diagnostic Trouble Codes) and Transmission Adaptive Tables.
2. Drive the vehicle until the engine and transmission reach normal operating temperature.
3. Accelerate from a stop with light throttle (15%) ensuring that upshifts 1st through 8th occur at engine speeds between 1300-1600 rpm.
4. Continue to accelerate (may apply slightly more throttle after 7-8 upshift at 32-38 mph (51-61 km/h) until you achieve 55 mph (88 km/h) and the 8-9 and 9-10 shifts complete.
5. Brake very gently to a complete stop and hold foot on brake for five (5) seconds.
6. Shift the transmission to Neutral. Wait 1 second.
7. Shift the transmission to Reverse. Wait 2 seconds.
8. Shift the transmission to Neutral. Wait 1 second.
9. Shift the transmission to Drive. Wait 2 seconds.
10. Repeat Steps 3 through 9 six additional times.

Ford 10R/GM 40L Rebuilding Essentials




Gear	A Clutch (1, 2, 3, 4, 5, 6, M1, M2, R)	B Clutch (8, 9, 10, M1, M2, R)	C Clutch (2, 3, 4, 5, 7, 9, 10, M2)	D Clutch (2, 3, 4, 6, 7, 8, 10, M2, R)	E Clutch (1, 3, 5, 6, 7, 8, 9, M1)	F Clutch (4, 5, 6, 7, 8, 9, 10, R)	Low - OWC
Park	H	H	-	H	-	-	-
Reverse	H	H	-	D	-	D	-
Neutral	H	H	-	_a	-	-	-
1st Gear D	H	O	-	_a	D	-	H
2nd Gear D	H	O	D	D	-	-	H
3rd Gear D	H	-	D	D	D	-	O/R
4th Gear D	H	-	D	D	-	D	O/R
5th Gear D	H	-	D	-	D	D	O/R
6th Gear D	H	-	-	D	D	D	O/R
7th Gear D	-	-	D	D	D	D	O/R
8th Gear D	-	H	-	D	D	D	-
9th Gear D	-	H	D	-	D	D	-
10th Gear D	-	H	D	D	-	D	-
1st Gear Manual	H	H	-	_a	D	-	H
2nd Gear Manual	H	H	D	D	-	-	H
Planetary Component	Ring Gear No. 1	Sun Gear No. 1 and Sun Gear No. 2	Ring Gear No. 2 and Sun Gear No. 3	Planetary No. 3	Ring Gear No. 3 and Sun Gear No. 4	Ring Gear No. 4 and Planetary No. 1	Sun Gear No. 1 and Sun Gear No. 2 in CW direction

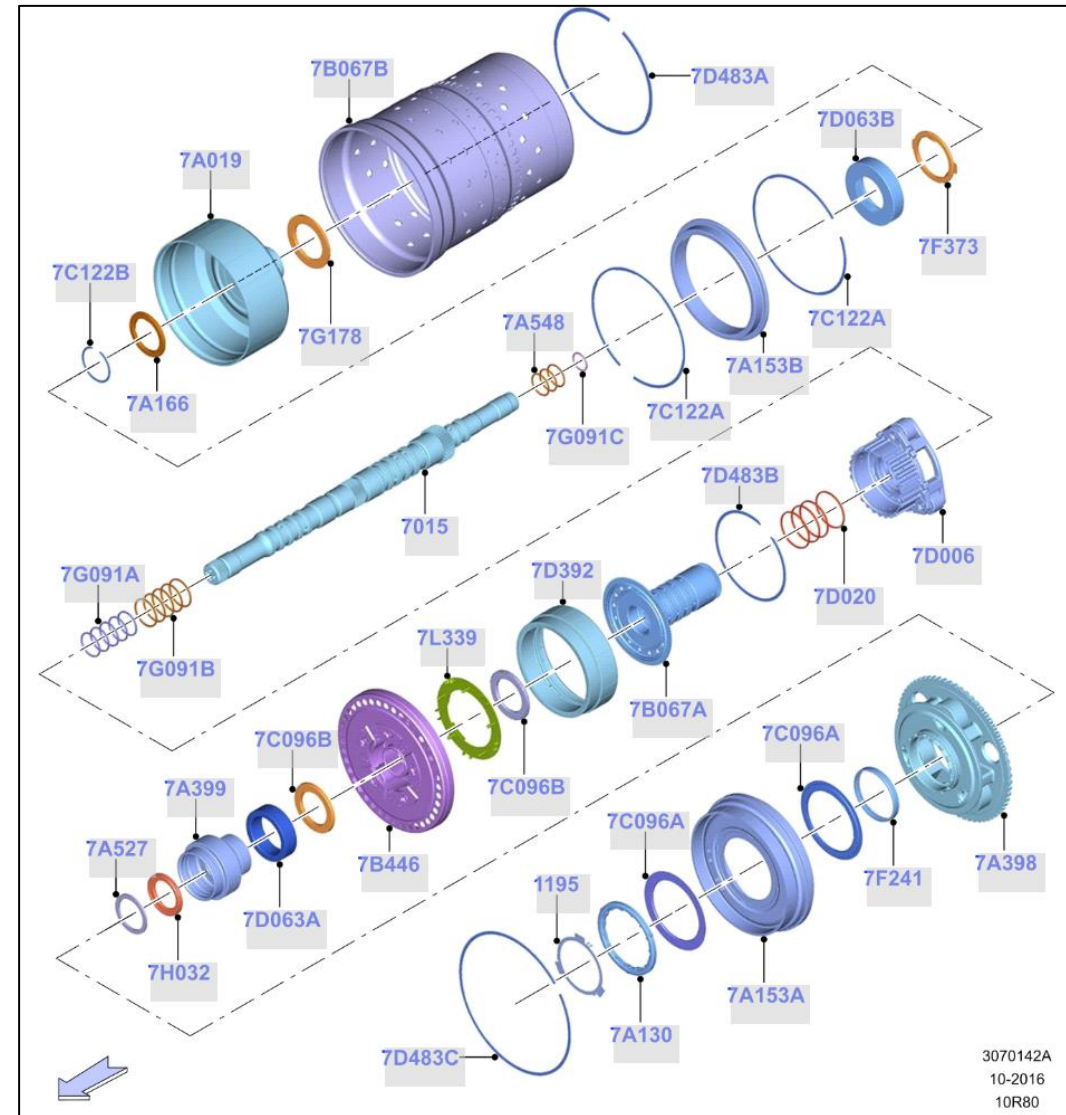
- 1 = A
- 2 = B
- 3 = C
- 4 = D
- 5 = E
- 6 = F
- 7 = 1-way

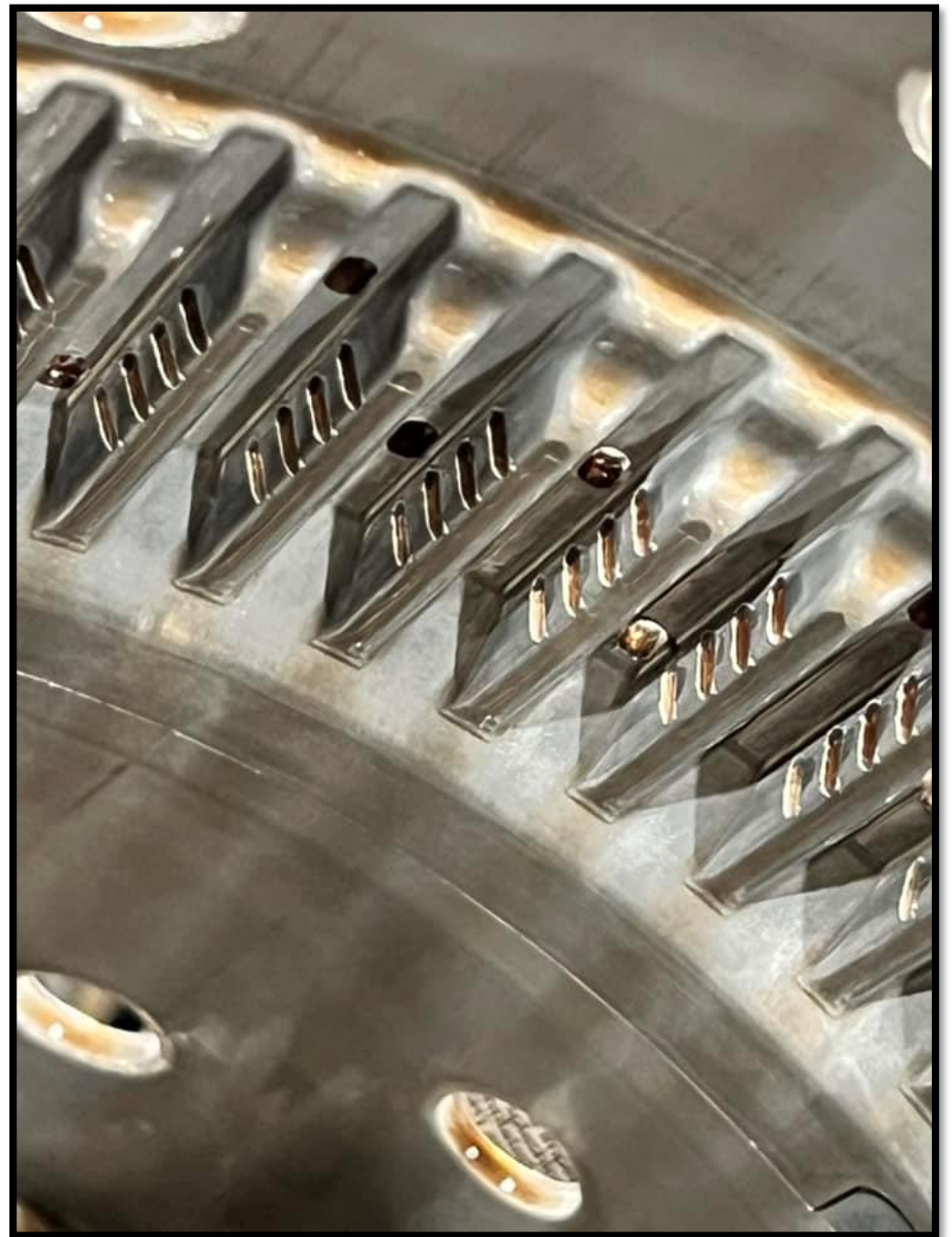


Trash Can F-clutch damage

- Steels wearing into the drum
- Make sure there are no engine misfires!

Part Number	Part Description	Brand	Promotion	Pricing
HL3Z7B177D	Hub	Ford	 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON...	List Price: \$183.33 Price: \$133.10





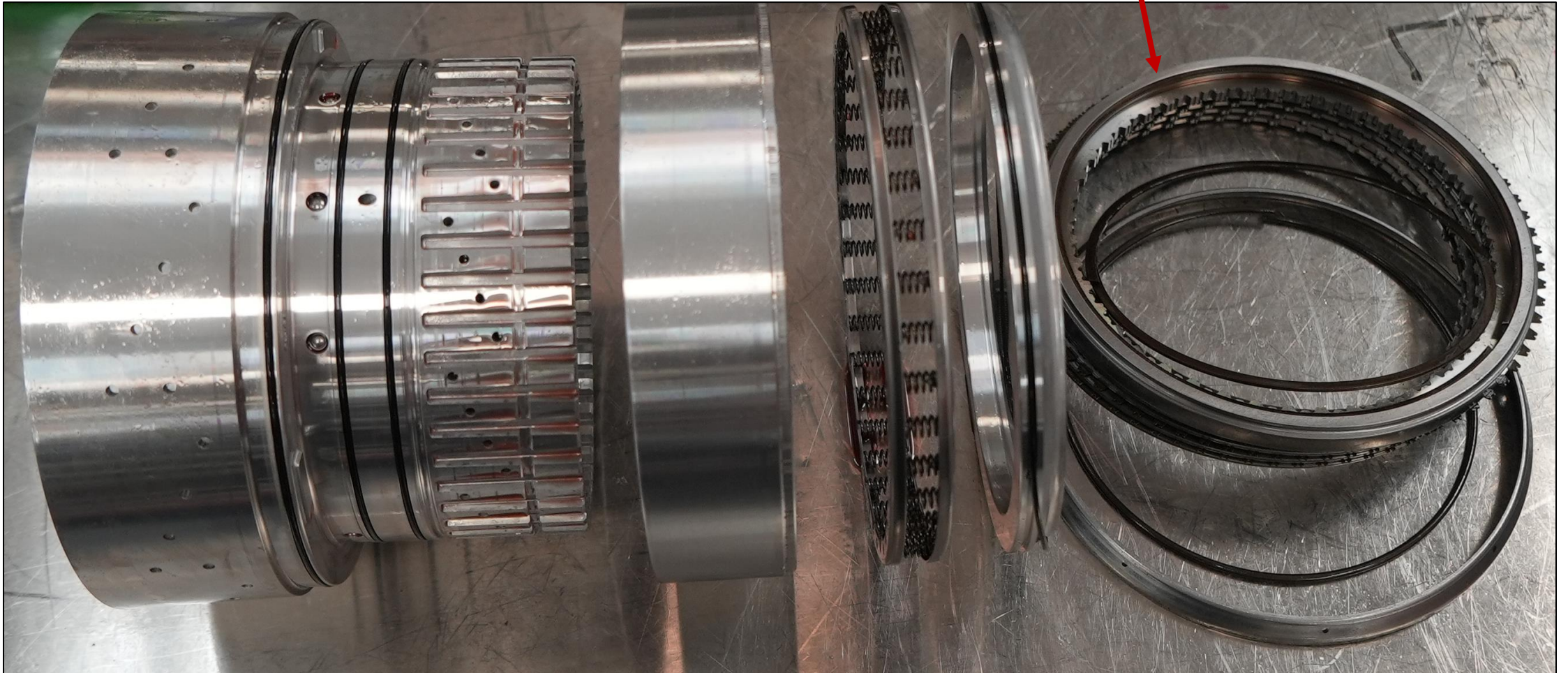
Trash Can F-clutch damage

- Wear on the top spline could allow the front planetary to shift and contact the sun gear



CDF clutch assembly

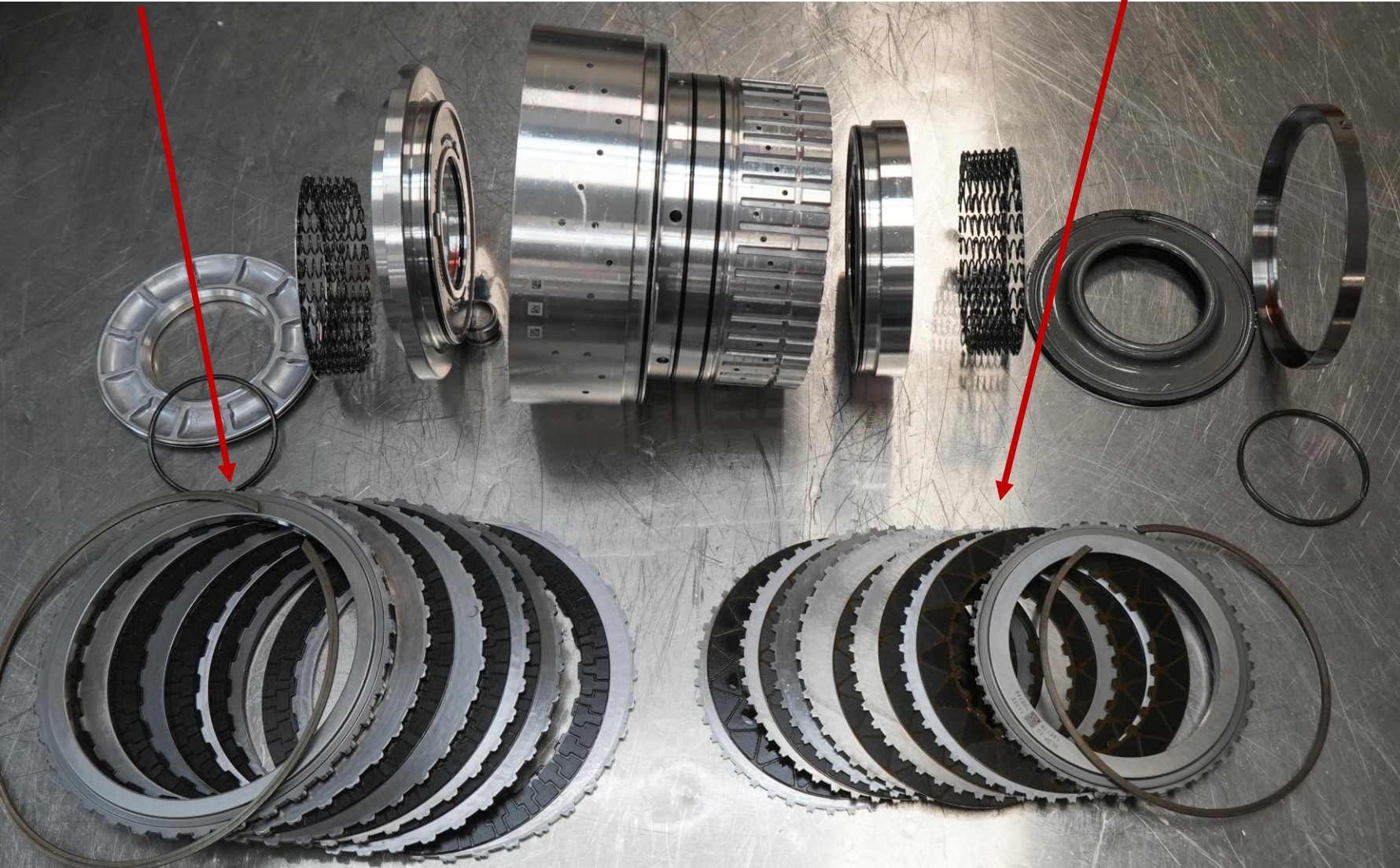
F clutch

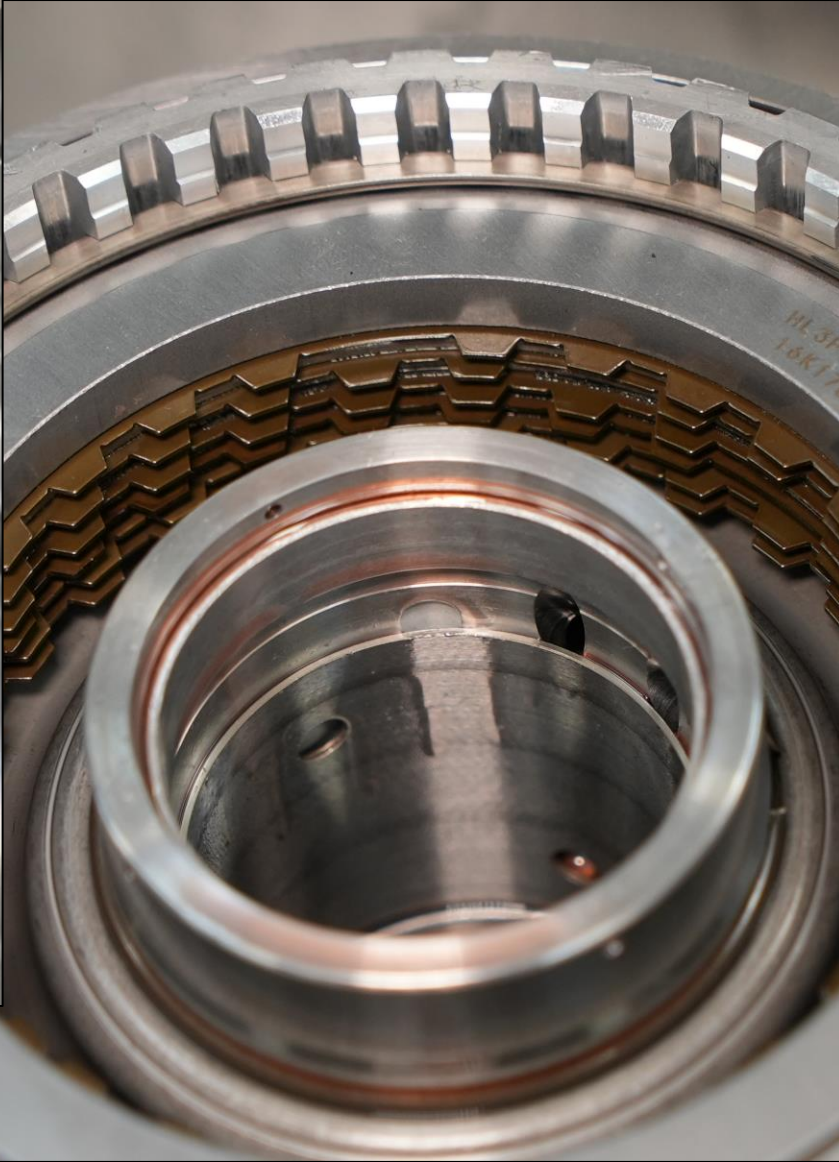


CDF clutch assembly

C clutch

D clutch






Rebuilding Particulars











- C (direct) clutch selective snap rings

ED MORSE FORD
Call Dealer

2019 Ford F-150 (VIN: 1FTEW1E55KKE44383) [VIN Attributes ?](#)

Parts List [Return to Catalog](#)

Add Parts to List **Add Part** Upload File CSV or text format **Choose File** and 

Part Number	Part Description	Brand	Promotion	Pricing	Req Qty	Availability	Delivery option	Net Price
HL3Z7C122B	Snap Ring	Ford	 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$20.00 Price: \$13.31	<input type="text" value="1"/>	1	Standard 	\$13.31
HL3Z7C122E	Snap Ring	Ford	 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$11.89 Price: \$7.91	<input type="text" value="1"/>	0	Standard 	\$7.91
HL3Z7C122A	Snap Ring	Ford	 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$20.55 Price: \$13.67	<input type="text" value="1"/>	1	Standard 	\$13.67
HL3Z7C122D	Snap Ring	Ford	 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$11.71 Price: \$7.79	<input type="text" value="1"/>	3	Standard 	\$7.79
HL3Z7C122C	Snap Ring	Ford	 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$7.51 Price: \$5.00	<input type="text" value="1"/>	1	Standard 	\$5.00

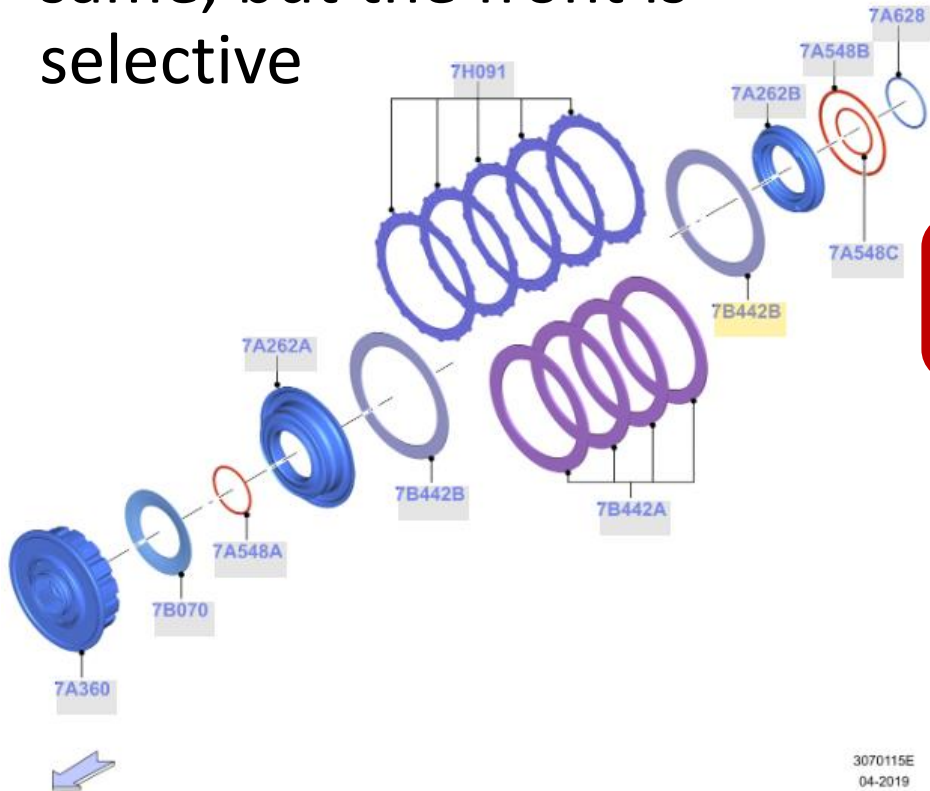
Rebuilding Particulars

- D (low) clutch selective snap rings

Part Number	Part Description	Brand	Promotion	Pricing	Req Qty	Availability	Delivery option	Net Price
HL3Z7D483C	Snap Ring	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON...	List Price: \$21.09 Price: \$14.04	1	1	Standard	\$14.04
HL3Z7D483E	Snap Ring	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON...	List Price: \$34.91 Price: \$23.23	1	0	Standard	\$23.23
HL3Z7D483B	Snap Ring	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON...	List Price: \$17.07 Price: \$11.36	1	1	Standard	\$11.36
HL3Z7D483D	Snap Ring	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON...	List Price: \$11.89 Price: \$7.91	1	1	Standard	\$7.91
HL3Z7D483A	Snap Ring	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON...	List Price: \$20.36 Price: \$13.55	1	1	Standard	\$13.55
HL3Z7D483F	Snap Ring	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON...	List Price: \$28.73 Price: \$19.12	1	0	Standard	\$19.12

Rebuilding Particulars

- E (forward) clutch selective plates
- Front and rear plate are the same, but the front is selective



3070115E
04-2019

Part Number	Part Description	Brand	Promotion	Pricing	Req Qty	Availability	Delivery option	Net Price
HL3Z7B066M	Plate - Clutch External Spline	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$22.17 Price: \$16.09	1	0	Standard	\$16.09
HL3Z7B066L	Plate - Clutch External Spline	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$7.78 Price: \$5.65	1	0	Standard	\$5.65
HL3Z7B066G	Plate - Clutch External Spline	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$22.17 Price: \$16.09	1	0	Standard	\$16.09
HL3Z7B066K	Plate - Clutch External Spline	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$22.17 Price: \$16.09	1	0	Standard	\$16.09
HL3Z7B066N	Plate - Clutch External Spline	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$7.78 Price: \$5.65	2	0	Standard	\$11.30
HL3Z7B066F	Plate - Clutch External Spline	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$7.40 Price: \$5.37	1	0	Standard	\$5.37
HL3Z7B066J	Plate - Clutch External Spline	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$7.78 Price: \$5.65	1	0	Standard	\$5.65
HL3Z7B066H	Plate - Clutch External Spline	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$7.40 Price: \$5.37	1	0	Standard	\$5.37

Rebuilding Particulars

- F (High) clutch selective snap rings

Part Number	Part Description	Brand	Promotion	Pricing	Req Qty	Availability	Delivery option	Net Price
HL3Z7H365D	Snap Ring	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$15.53 Price: \$11.28	1	0	Standard	\$11.28
HL3Z7H365F	Snap Ring	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$3.58 Price: \$2.60	1	0	Standard	\$2.60
HL3Z7H365G	Snap Ring	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$12.83 Price: \$9.32	1	0	Standard	\$9.32
HL3Z7H365C	Snap Ring	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$15.53 Price: \$11.28	1	0	Standard	\$11.28
HL3Z7H365E	Snap Ring	Ford	CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$12.83 Price: \$9.32	1	0	Standard	\$9.32

Rebuilding Particulars

- A (Intermediate) clutch selective plates

Part Number	Part Description	Brand	Promotion	Pricing	Req Qty	Availability	Delivery option	Net Price
HL3Z7B066X	Plate	Ford	📄 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$29.67 Price: \$21.54	<input type="text" value="1"/>	1	Standard ▾	\$21.54
HL3Z7B066AA	Plate	Ford	📄 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$30.67 Price: \$22.26	<input type="text" value="1"/>	1	Standard ▾	\$22.26
HL3Z7B066Y	Plate	Ford	📄 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$9.77 Price: \$7.09	<input type="text" value="1"/>	0	Standard ▾	\$7.09
HL3Z7B066Z	Plate	Ford	📄 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$28.33 Price: \$20.57	<input type="text" value="1"/>	1	Standard ▾	\$20.57
HL3Z7B066W	Plate	Ford	📄 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$32.33 Price: \$23.47	<input type="text" value="1"/>	1	Standard ▾	\$23.47

Rebuilding Particulars

- B (OD) clutch snap rings

Part Number	Part Description	Brand	Promotion	Pricing	Req Qty	Availability	Delivery option	Net Price
HL3Z7D483S	Retainer	Ford	📞 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$29.45 Price: \$19.60	<input type="text" value="1"/>	0	Standard ▾	\$19.60
HL3Z7M157C	Retainer	Ford	📞 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$29.45 Price: \$19.60	<input type="text" value="1"/>	0	Standard ▾	\$19.60
HL3Z7M157B	Retainer	Ford	📞 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$12.69 Price: \$8.45	<input type="text" value="1"/>	0	Standard ▾	\$8.45
HL3Z7M157E	Retainer	Ford	📞 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$29.45 Price: \$19.60	<input type="text" value="1"/>	0	Standard ▾	\$19.60
HL3Z7M157D	Retainer	Ford	📞 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$29.45 Price: \$19.60	<input type="text" value="1"/>	0	Standard ▾	\$19.60
HL3Z7M157A	Retainer	Ford	📞 CALL WHOLESALE PARTS FOR COMPETITIVE PRICING ON ENGINES, TRANSMISSIONS AND TRANSFER CASES!	List Price: \$29.45 Price: \$19.60	<input type="text" value="1"/>	0	Standard ▾	\$19.60

Transmission Tuning

- Best practices

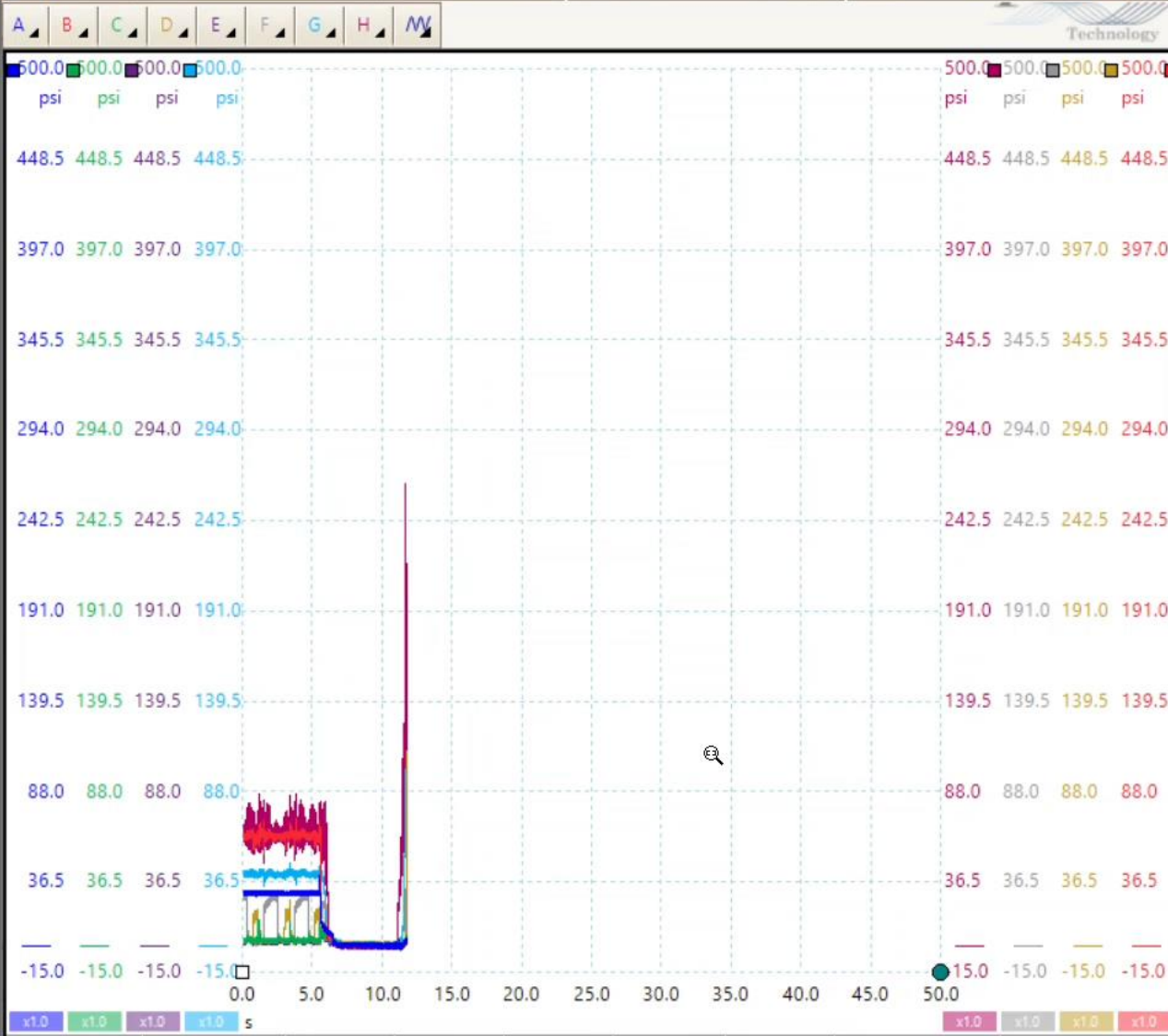
- Match transmission performance to engine performance
- Durability vs. Performance
- Know what changes what?
- Know what normal is before changing anything
- Understand what scan data is showing you
 - Command vs. Actual

- Worst Practices

- Not having a plan!
- Assume tables change operation without verifying
- Remove torque management without proper mechanical modifications
- Assume that scan data values are actual values (clutch pressures)

10L80 Tuning

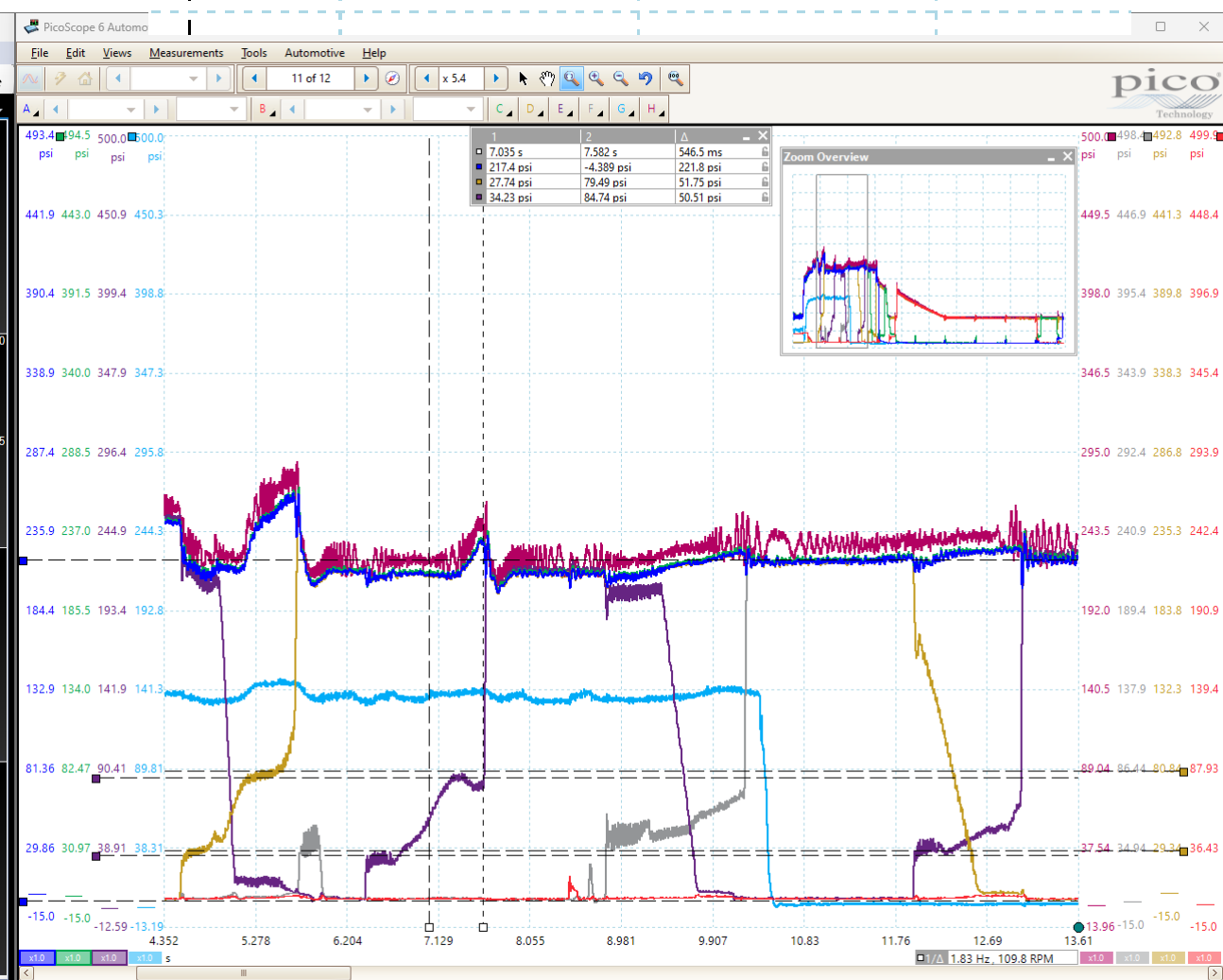
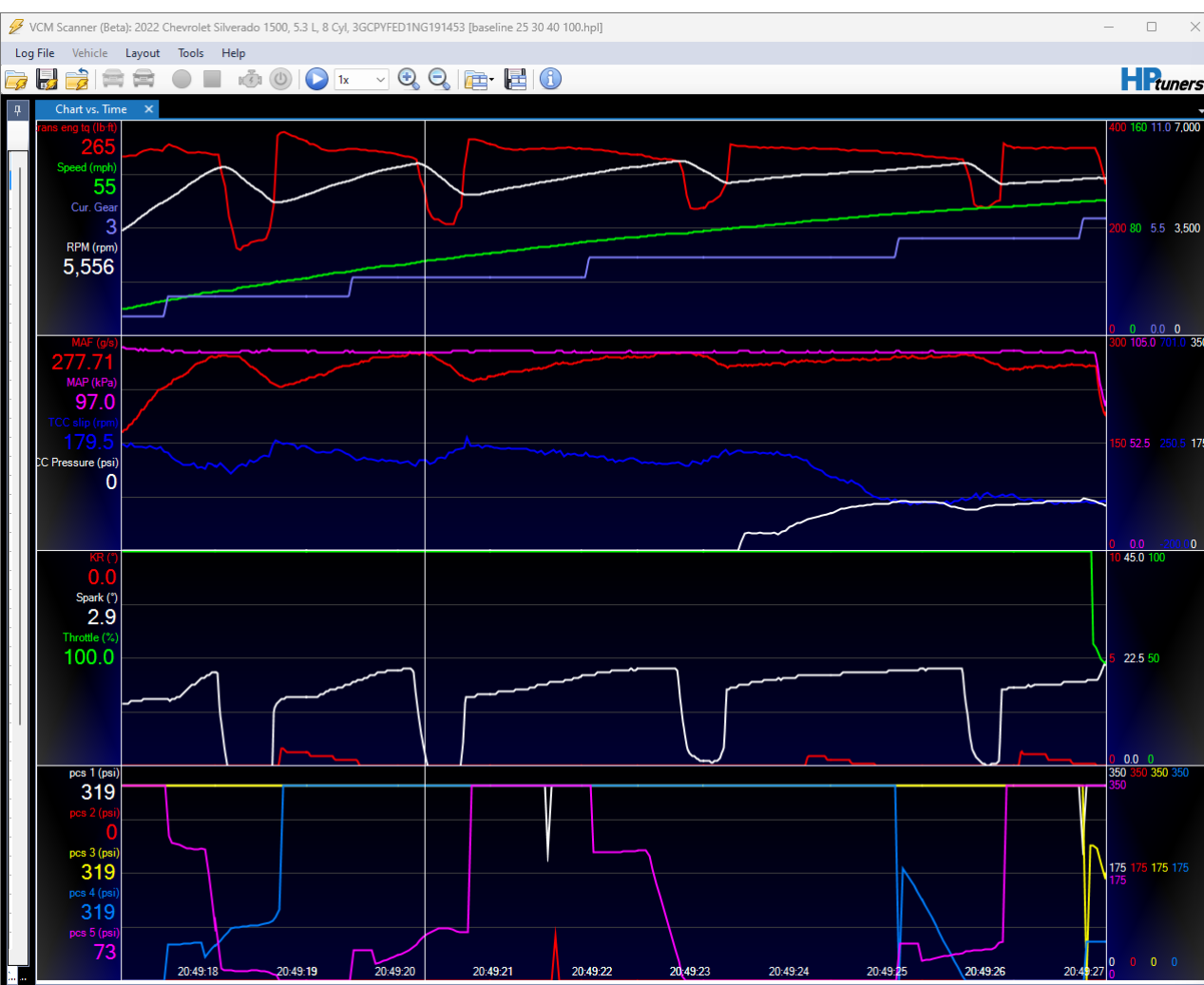
- 2022 Silverado with clutches tapped for pressure
- Baseline
- What changed?
 - Shift time
 - Desired output torque factor
 - Torque management
- What didn't change?
 - Baseline pressure
 - Max pressure
 - Base pressure offset



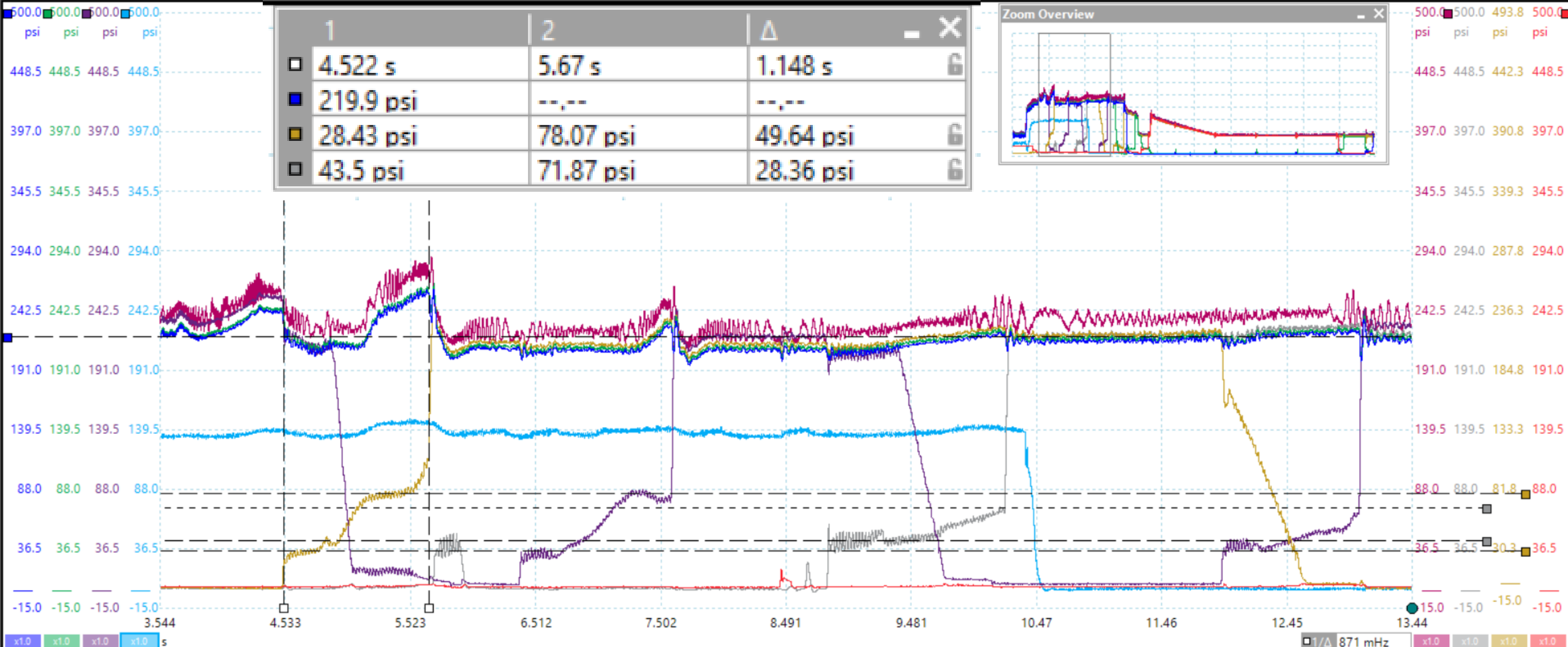
Tuning – what changes?

- Baseline Pressure

1	2	Δ	
7.035 s	7.582 s	546.5 ms	
217.4 psi	-4.389 psi	221.8 psi	
27.74 psi	79.49 psi	51.75 psi	
34.23 psi	84.74 psi	50.51 psi	



Shift Pressures - Baseline

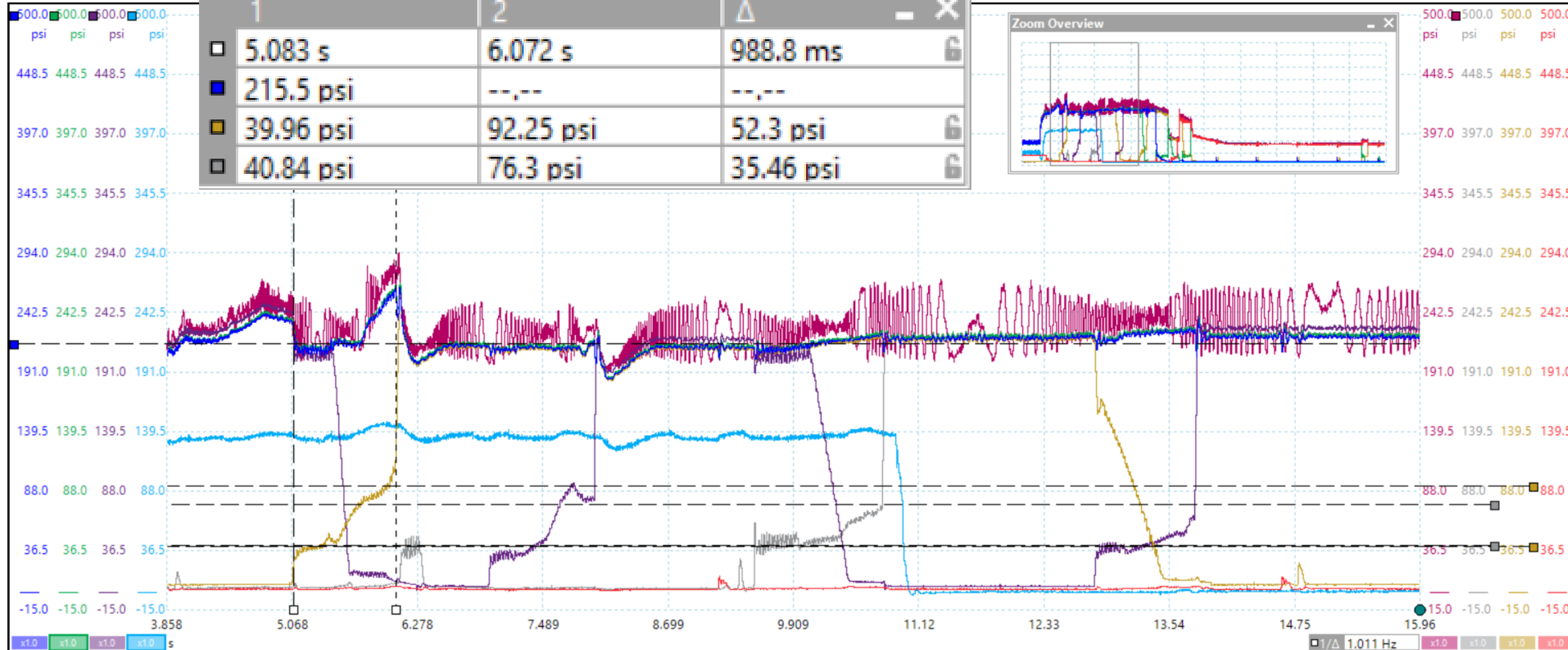
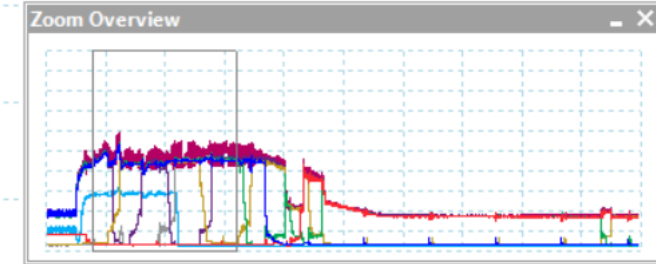


Tuning – what changes?

Shift time decreased 30%

1	2	Δ	
4.522 s	5.67 s	1.148 s	
219.9 psi	---	---	
28.43 psi	78.07 psi	49.64 psi	
43.5 psi	71.87 psi	28.36 psi	

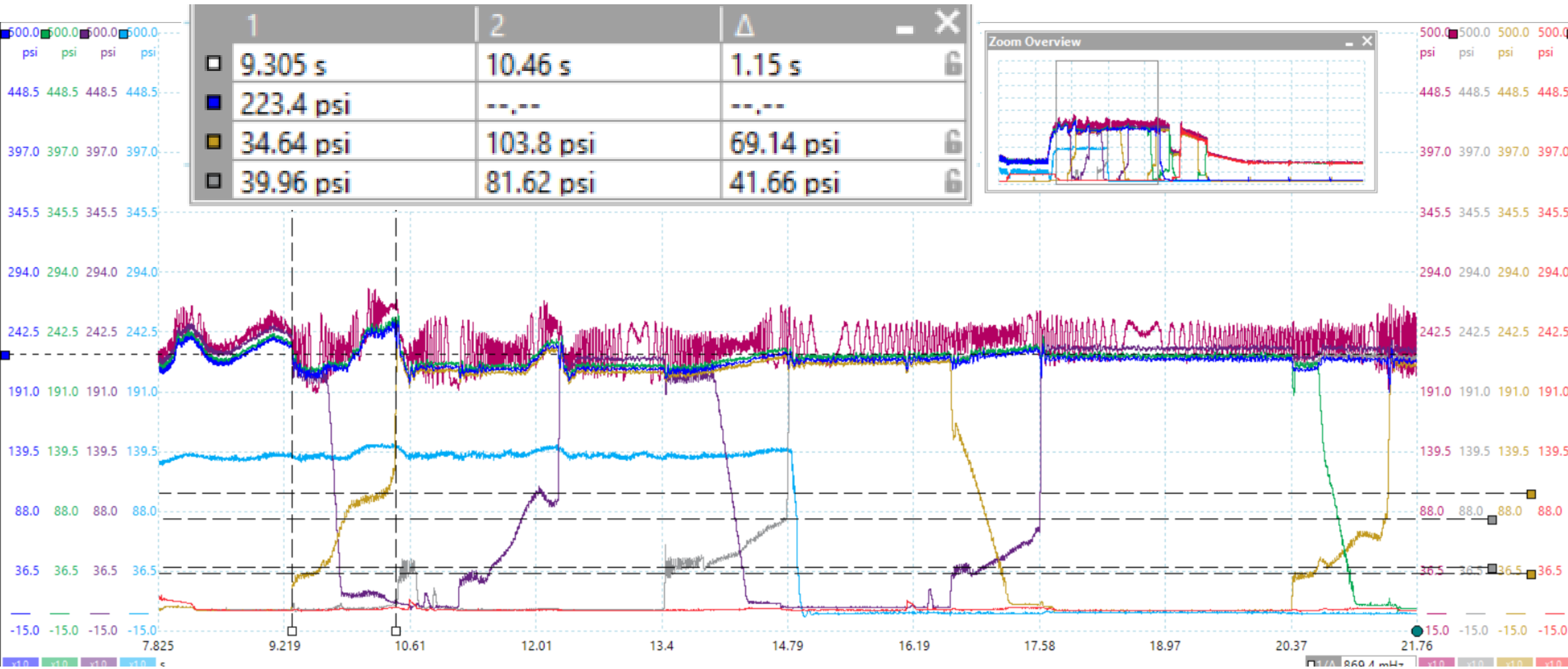
1	2	Δ	
5.083 s	6.072 s	988.8 ms	
215.5 psi	---	---	
39.96 psi	92.25 psi	52.3 psi	
40.84 psi	76.3 psi	35.46 psi	



Tuning – what changes?

Desired Output Torq Factor +30%

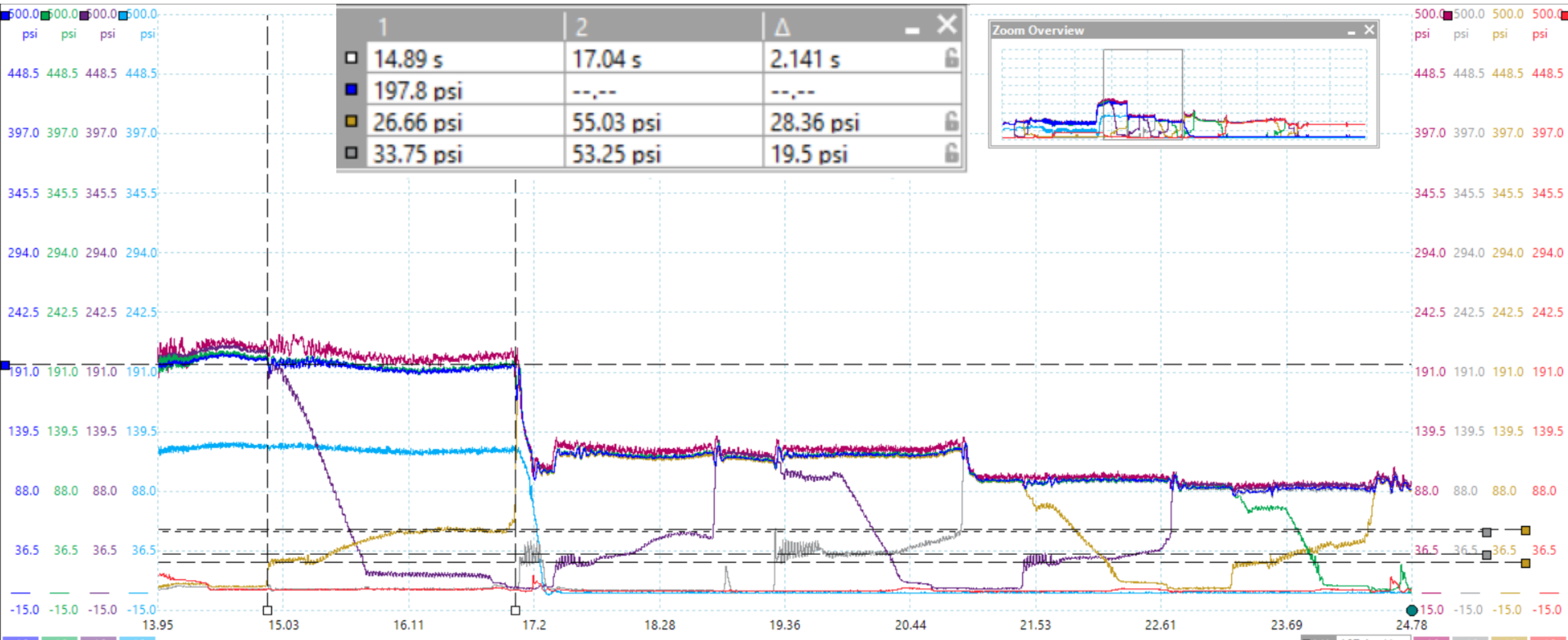
	1	2	Δ	
□	4.522 s	5.67 s	1.148 s	🔒
■	219.9 psi	---	---	
■	28.43 psi	78.07 psi	49.64 psi	🔒
□	43.5 psi	71.87 psi	28.36 psi	🔒



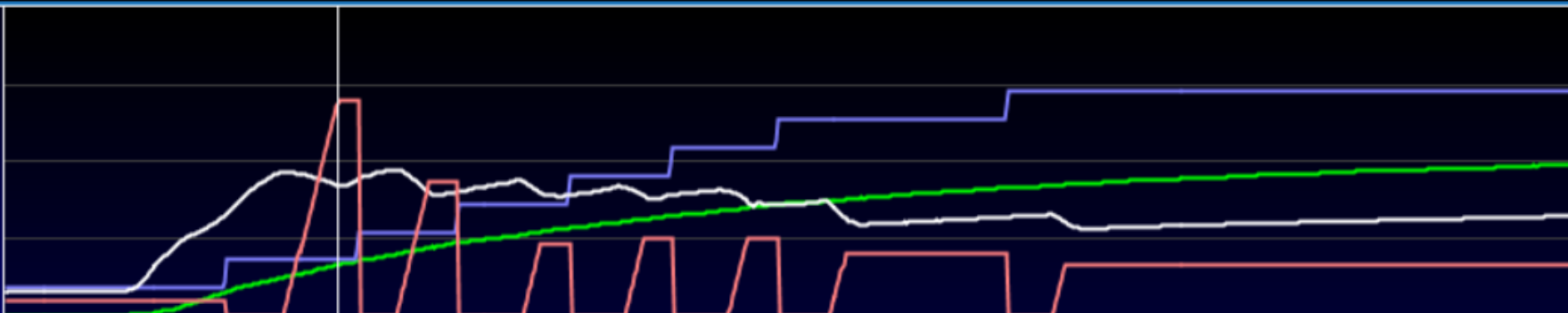
Tuning – what changes?

Disable torque management

Note: this was at 40% throttle because the trans was slipping

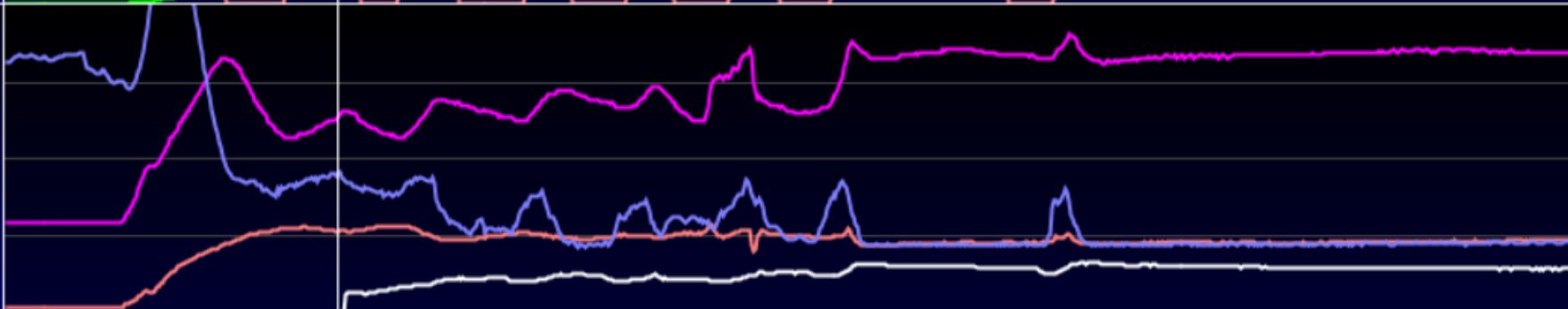


Speed (mph) **27**
 Cur. Gear **2**
 RPM (rpm) **2,970**



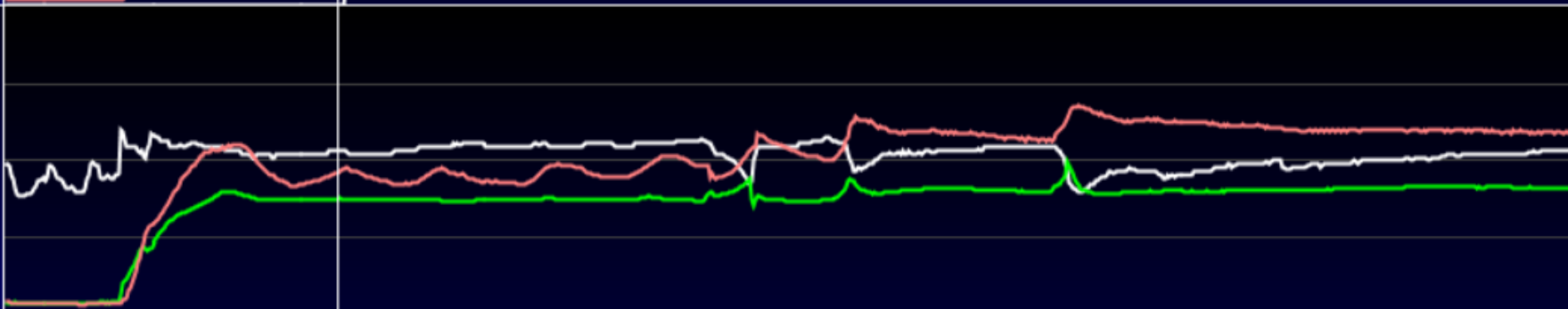
160 11.0 7,000 1,500
 80 5.5 3,500 750
 0 0.0 0 0

MAF (g/s) **79.67**
 MAP (kPa) **67.0**
 TCC slip (rpm) **215.9**



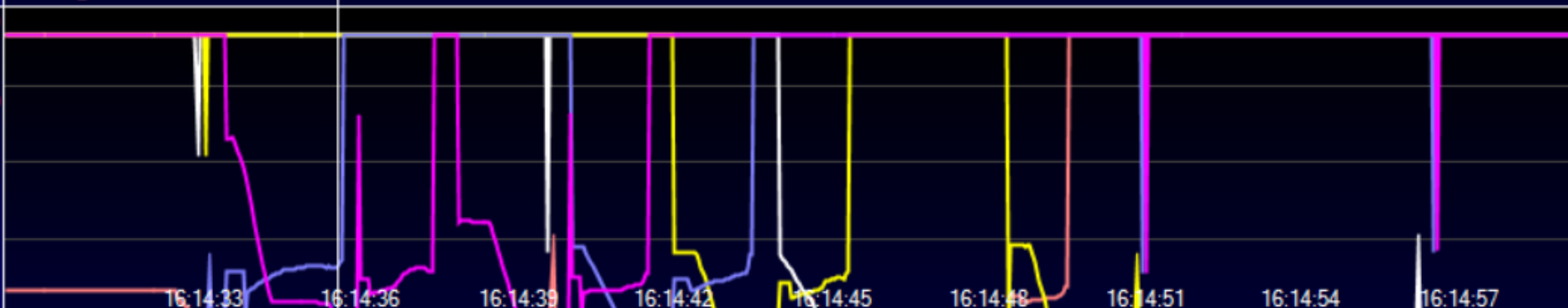
300 105.0 701.0 350
 150 52.5 250.5 175
 0 0.0 -200.00

Spark (°) **24.0**
 Throttle (%) **37.7**
 Trans eng tq (lb-ft) **185**



45.0 100 400
 22.5 50 200
 0.0 0 0

pcs 1 (psi) **319**
 pcs 2 (psi) **0**
 pcs 3 (psi) **319**



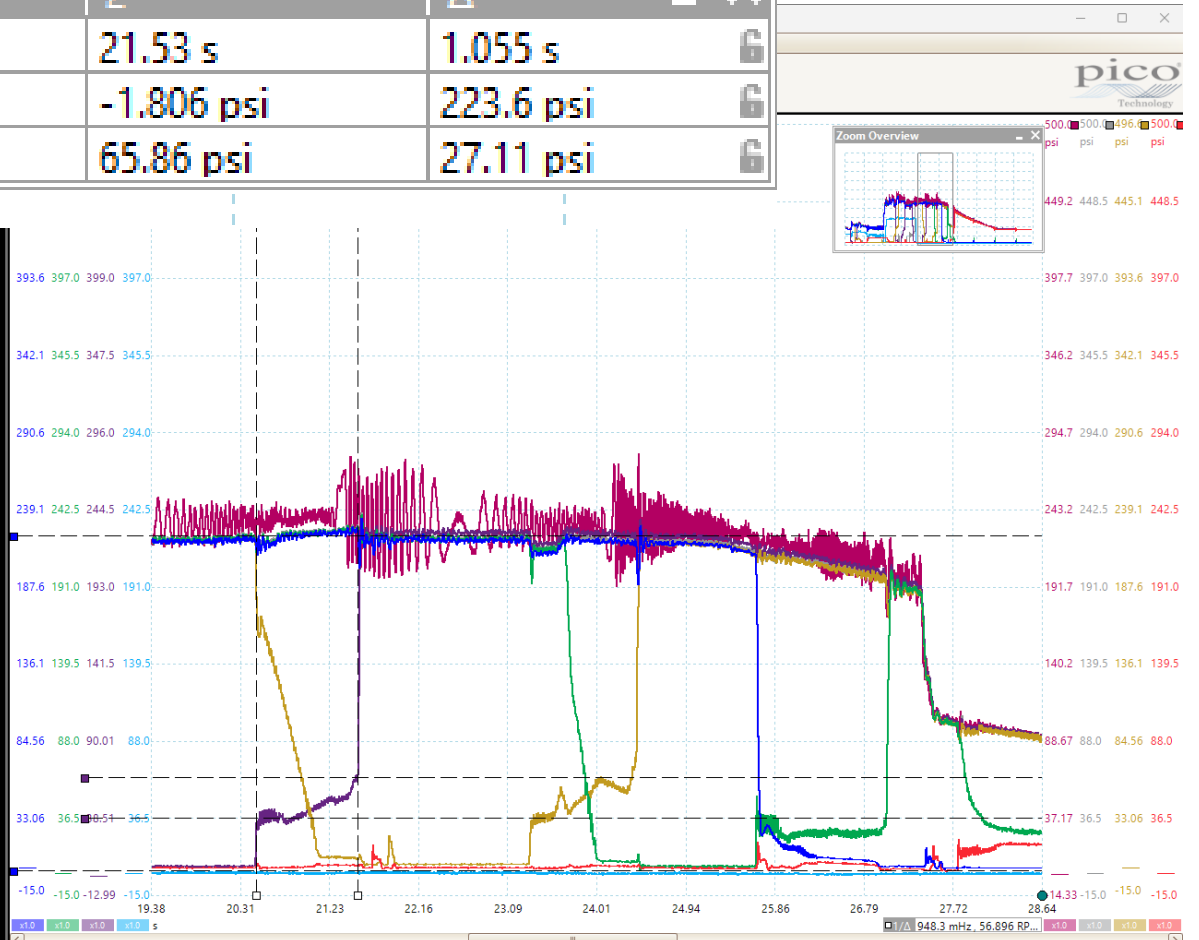
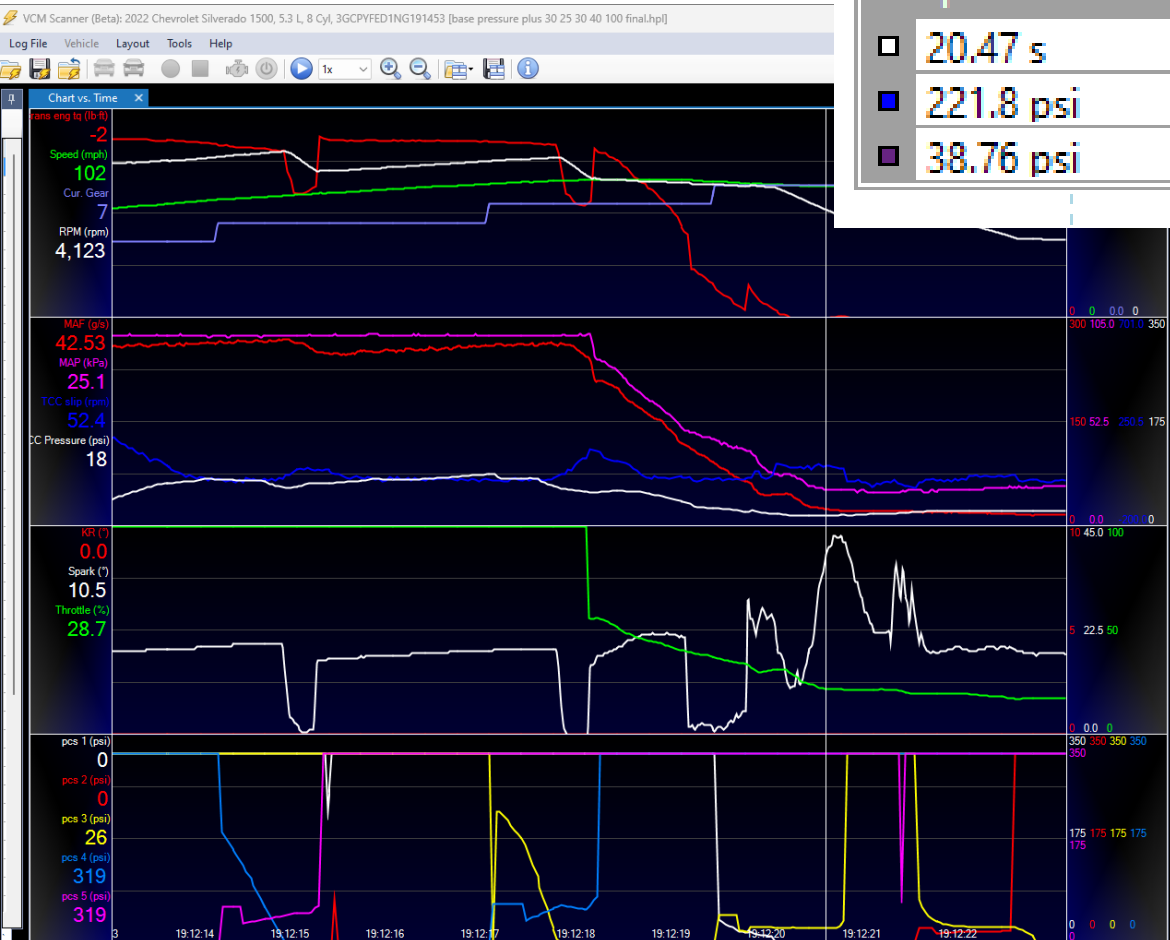
350 350 350 350
 350
 175 175 175 175
 175
 0 0 0 0
 0

Tuning – what changes?

- Base Pressure increase 30%

1	2	Δ
4.522 s	5.67 s	1.148 s
219.9 psi	--,--	--,--
28.43 psi	78.07 psi	49.64 psi
43.5 psi	71.87 psi	28.36 psi

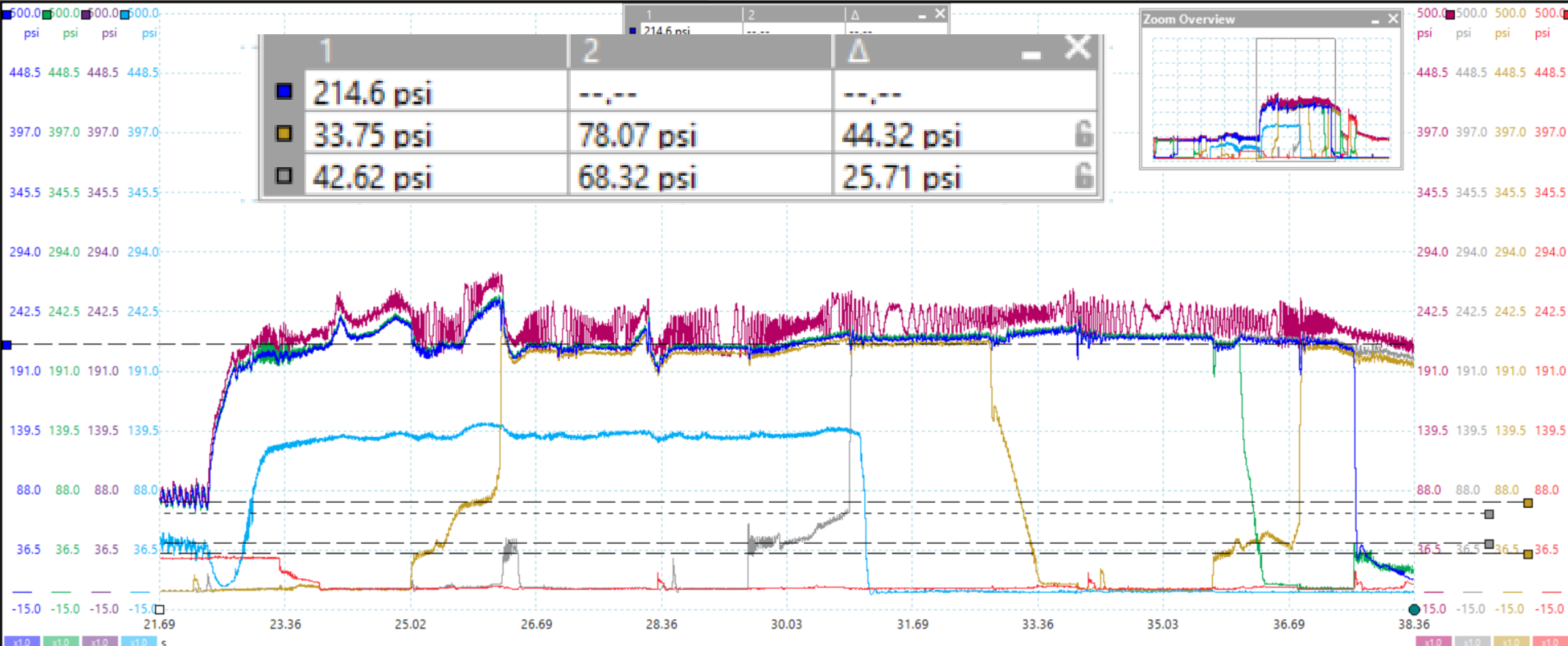
1	2	Δ
20.47 s	21.53 s	1.055 s
221.8 psi	-1.806 psi	223.6 psi
38.76 psi	65.86 psi	27.11 psi



Tuning – what changes?

Max Press set to 250

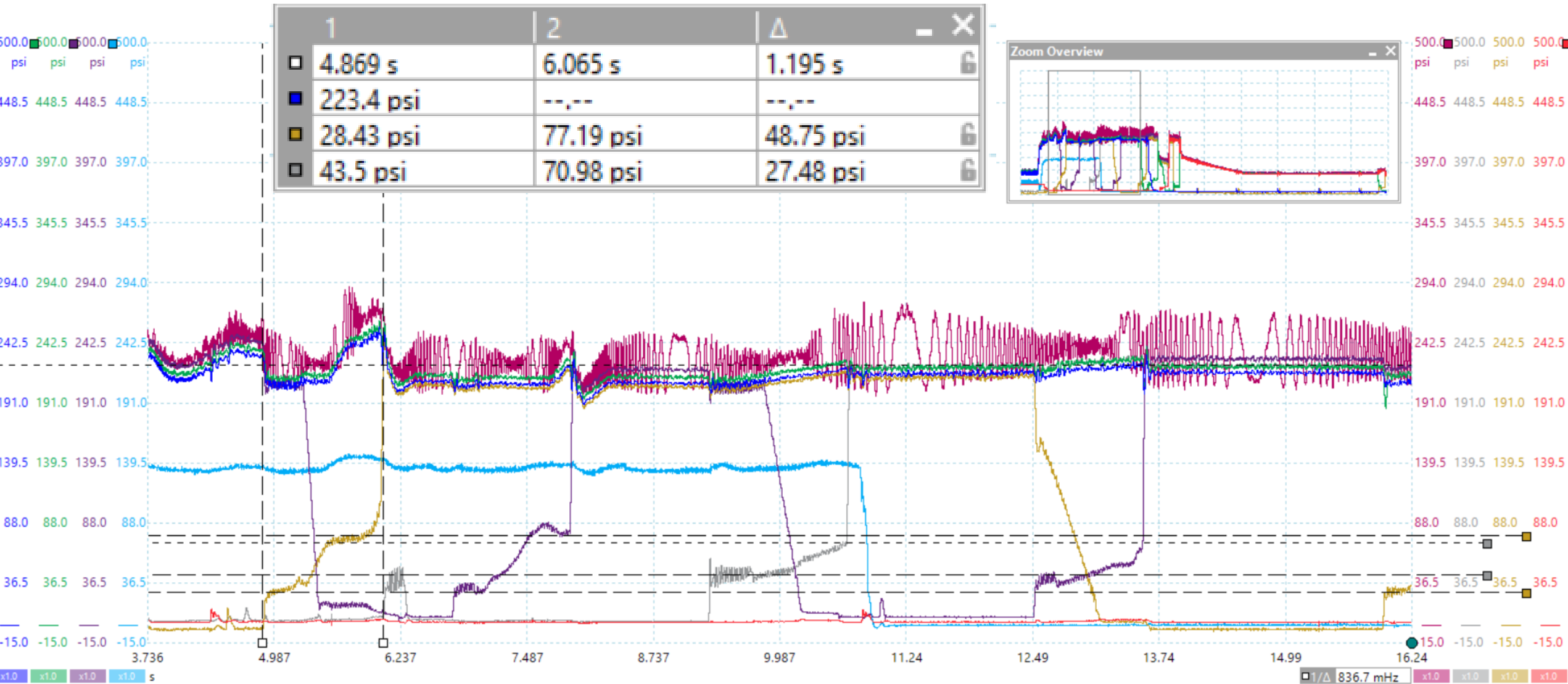
	1	2	Δ
□	4.522 s	5.67 s	1.148 s
■	219.9 psi	---	---
■	28.43 psi	78.07 psi	49.64 psi
□	43.5 psi	71.87 psi	28.36 psi



Tuning – what changes?

Base pressure offset +30%

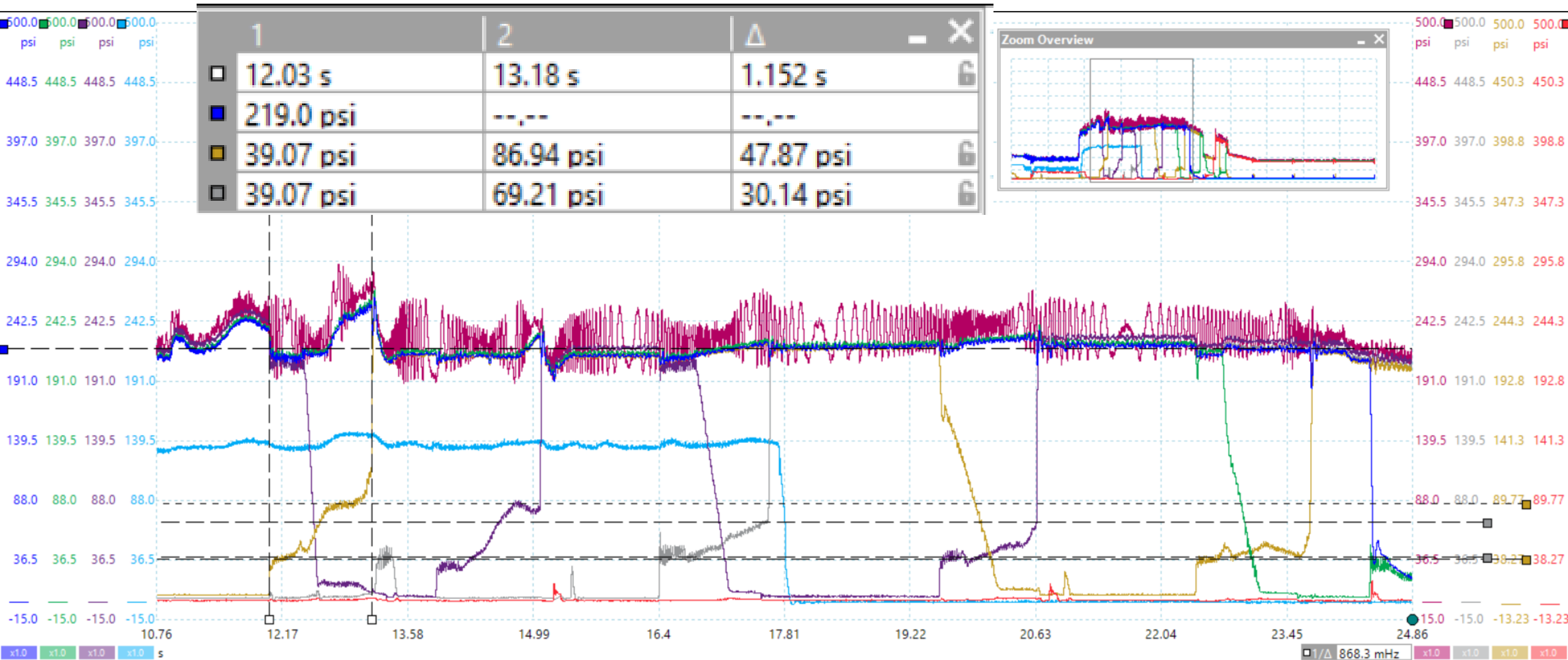
1	2	Δ	
4.522 s	5.67 s	1.148 s	
219.9 psi	---	---	
28.43 psi	78.07 psi	49.64 psi	
43.5 psi	71.87 psi	28.36 psi	



Tuning – what changes?

Transition time reduced 30%

1	2	Δ	
4.522 s	5.67 s	1.148 s	
219.9 psi	---	---	
28.43 psi	78.07 psi	49.64 psi	
43.5 psi	71.87 psi	28.36 psi	



HP tuners – 6L

- Many techs modify the TCC application and disable Active and Dynamic Fuel Management (displacement on demand)
- The following slides cover modifications that can be performed using tuning software such as HPTuners
- Experiment at your own risk

The screenshot displays the Transmission tuning software interface. The window title is "Transmission" and it features several tabs: General, Manual, Shift General, Shift Scheduling, Shift Pressures, Shift Timing, Torque Converter, and Torque Management. The "General" tab is active, showing three sections: "General", "Configuration", and "Cmd Gear Control Limits".

General

- ECM Trans Type: Auto
- ECM Auto Trans Type: C2C

Configuration

- VSS/OSS Location: After Gearbox

Gear Ratios

Gear	Ratio	Unit
1st Gear	4.56	:1
2nd Gear	2.97	:1
3rd Gear	2.08	:1
4th Gear	1.69	:1
5th Gear	1.27	:1
6th Gear	1.00	:1
7th Gear	0.84	:1
8th Gear	0.65	:1
Reverse	3.82	:1

Cmd Gear Control Limits

- Max RPM: 5,500 rpm
- Max Speed: 230 mph
- Upshift Min Speed
- Downshift Max Speed

[TCM] 16001 - Cmd Gear Downshift Max Vehicle Speed: VSS must be above this for Commanded Gear PCM Control to downshift.

0 to 512 mph

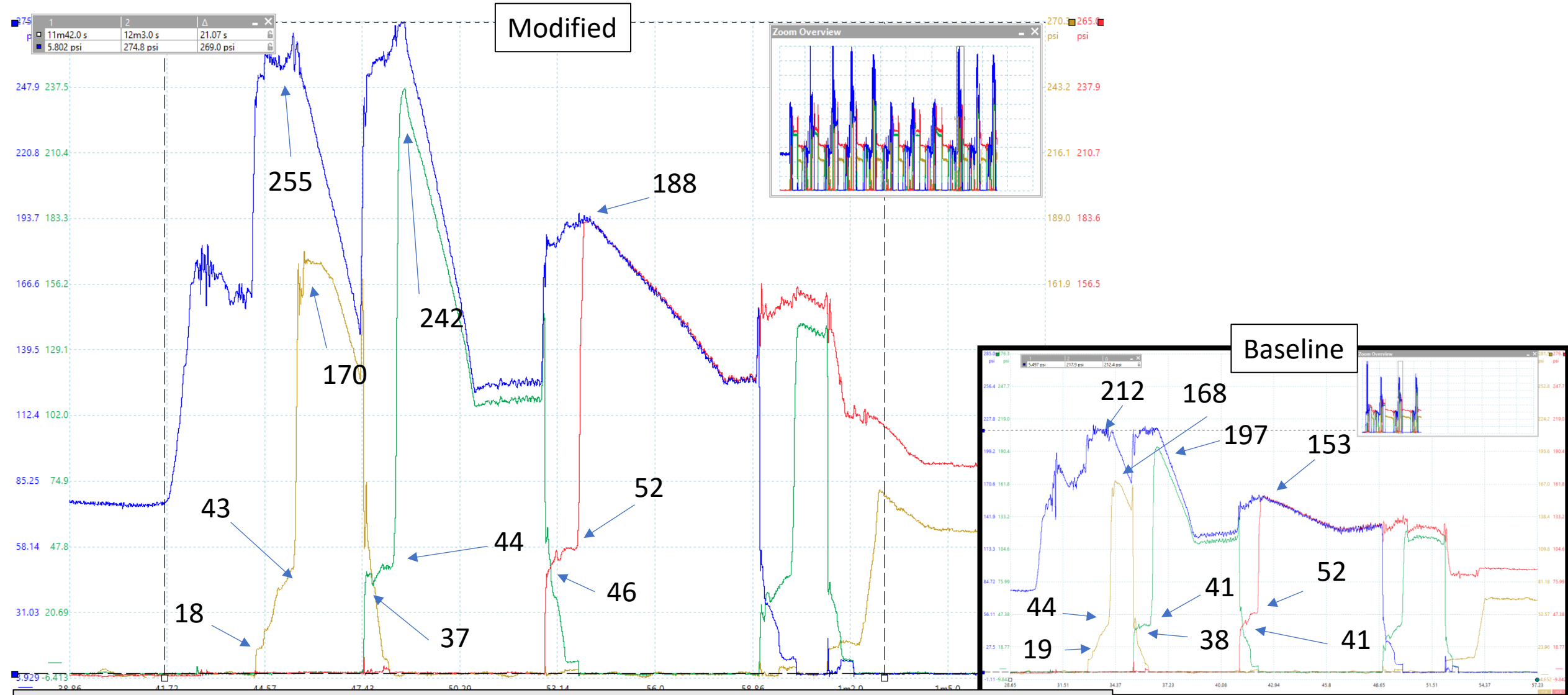
HP tuners

- Modifications that make a significant change
 - Shift Pressure XYZ
 - Torque Adder
 - Transition Time
 - TCC Ramp, Gain, Offset IF modifications were made

The screenshot displays a software interface for transmission tuning, titled "Transmission". It features several tabs: "General", "Manual", "Shift General", "Shift Scheduling", "Shift Pressures", and "Shift Timing". The "Shift Pressures" tab is active, showing three shift patterns: "Pattern X", "Pattern Y", and "Pattern Z". Each pattern is represented by a grid of buttons for gear shifts (e.g., 1-2, 2-3, 3-4, 4-5, 5-6, 1-3, 1-4, 2-4, 2-6, 3-5, 4-6). Below the patterns are three data tables, each titled "[TCM] [ID] - Base Shift Pressure 1-2 Pattern [X/Y/Z]". Each table has a vertical axis for "Transmission Oil Temp" with values -22, 14, 68, 86, and 257. The horizontal axis is labeled "Torque" with values 0, 111, 221, 332, and 443. The data cells in the tables are color-coded (blue, green, yellow, orange) and contain numerical values representing shift pressures. A footer note reads: "[TCM] 15901 - Base Shift Pressure 2-4 Pattern Z: The base line pressure (main line feed pressure solenoid) during a shift."

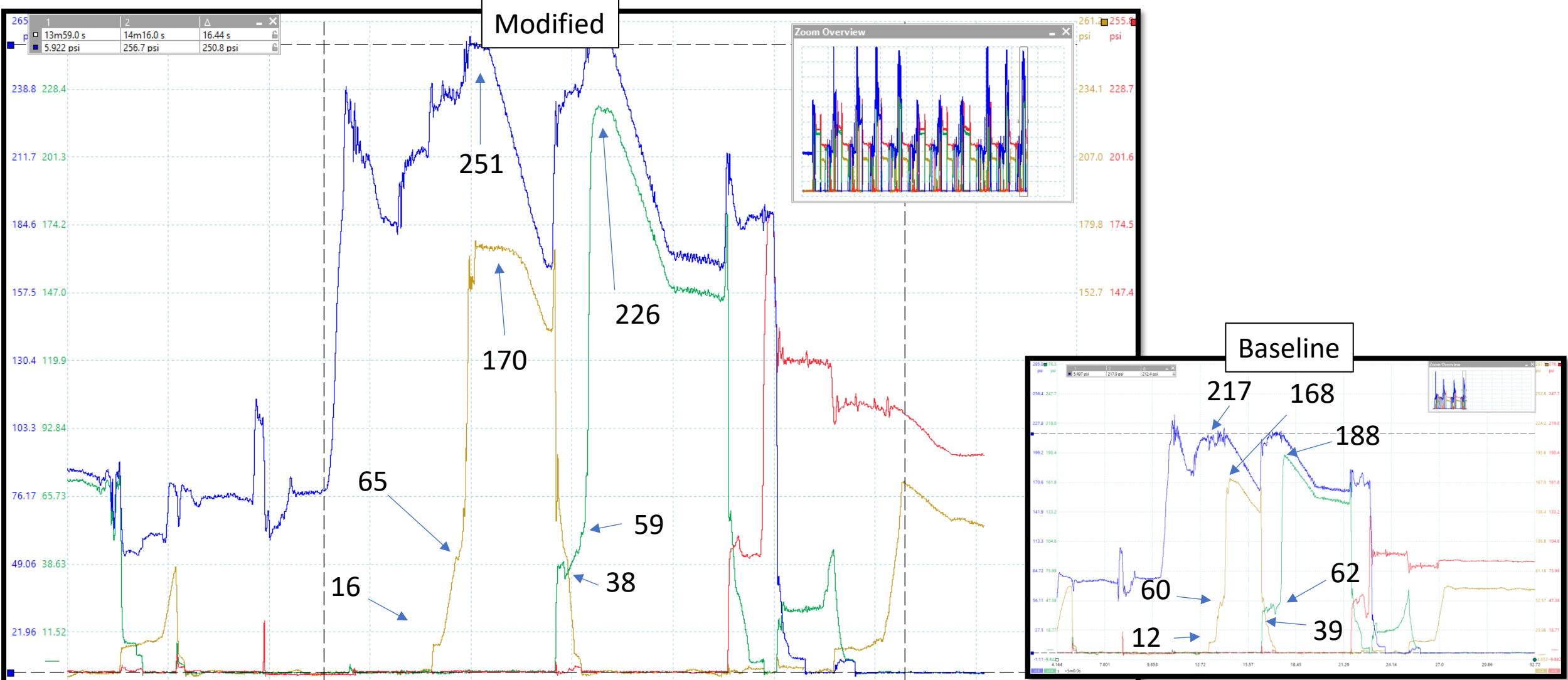
	0	111	221	332	443
-22	145.0	145.0	145.0	174.0	203.1
14	102.1	116.0	131.1	167.1	203.1
68	73.1	94.0	116.0	160.1	203.1
86	73.1	94.0	116.0	160.1	203.1
257	73.1	94.0	116.0	160.1	203.1

HP tuners: Increase shift pressure X,Y,Z 30%



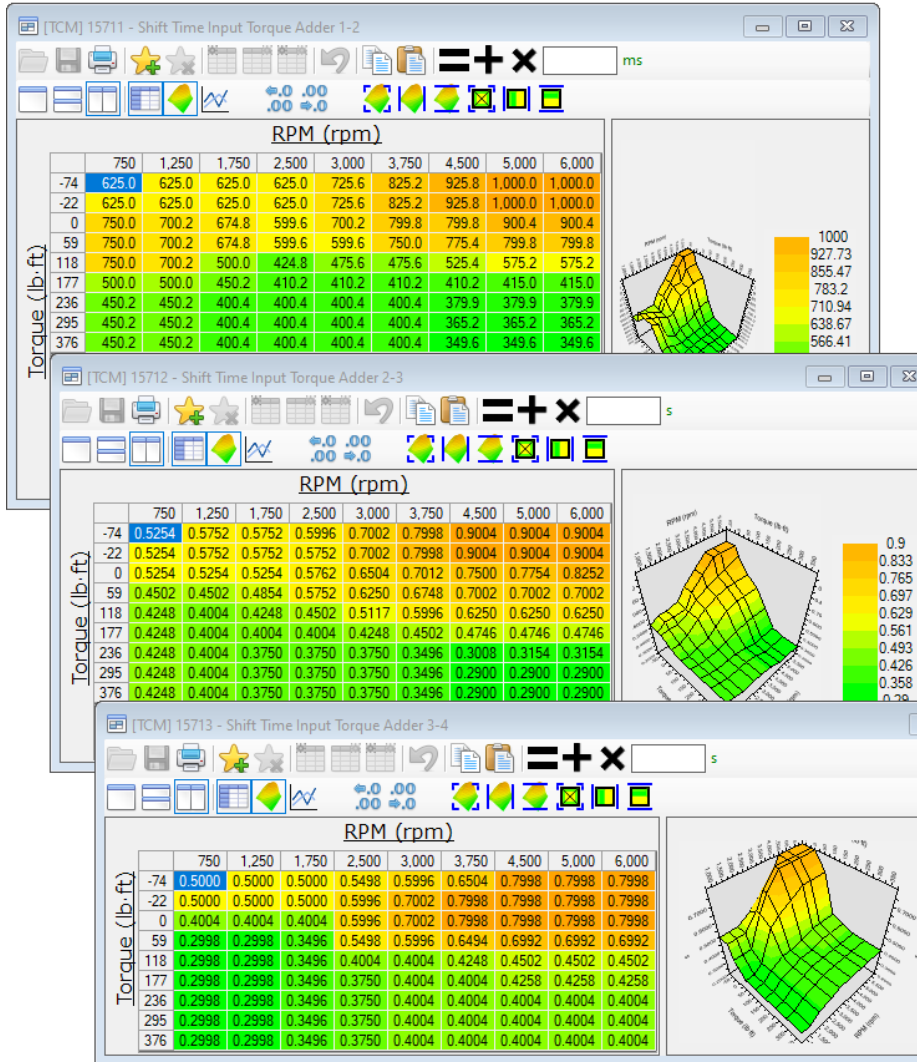
40% throttle. Note the clutch holding (line) pressures are much higher, but the fill, torque, and inertia pressures don't alter much

HP tuners: Increase shift pressure X,Y,Z 30%

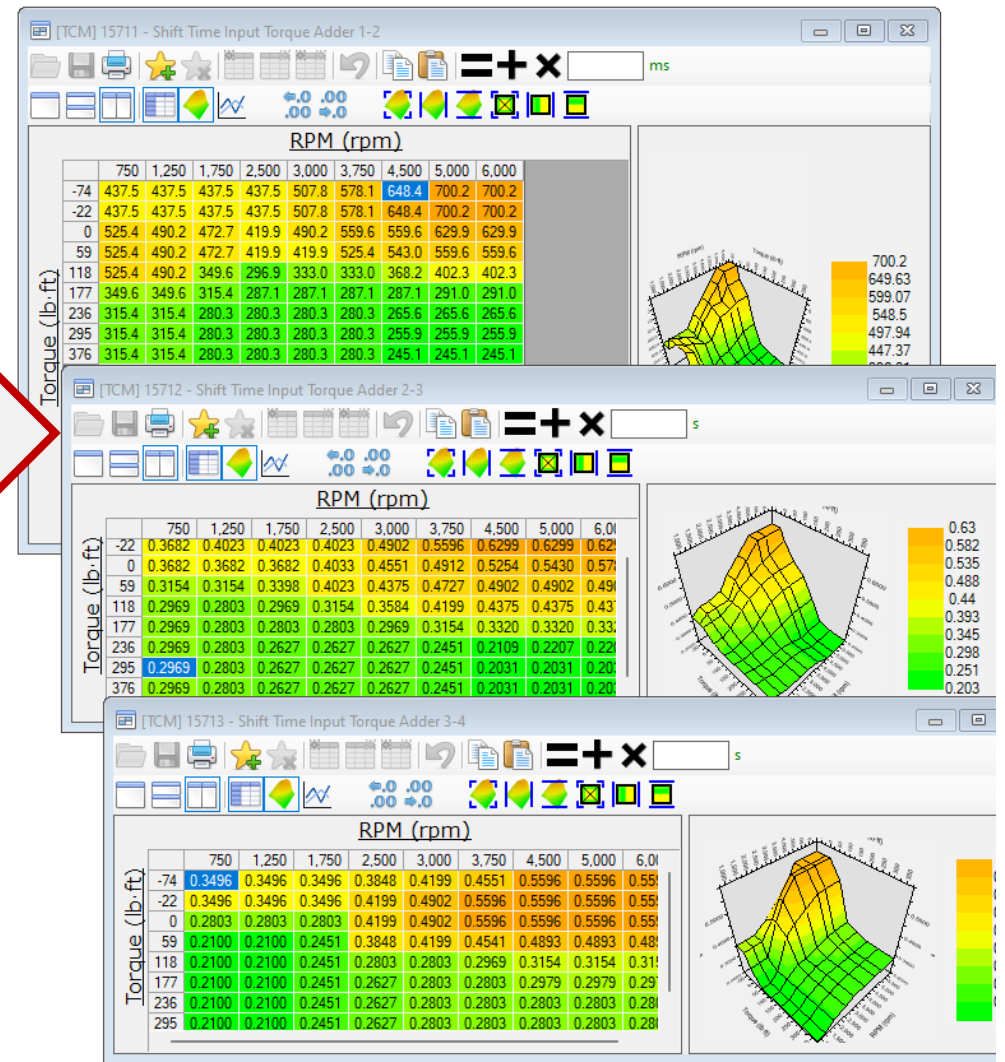


WOT throttle. Note the clutch holding (line) pressures are much higher, but the fill, torque, and inertia pressures don't alter much

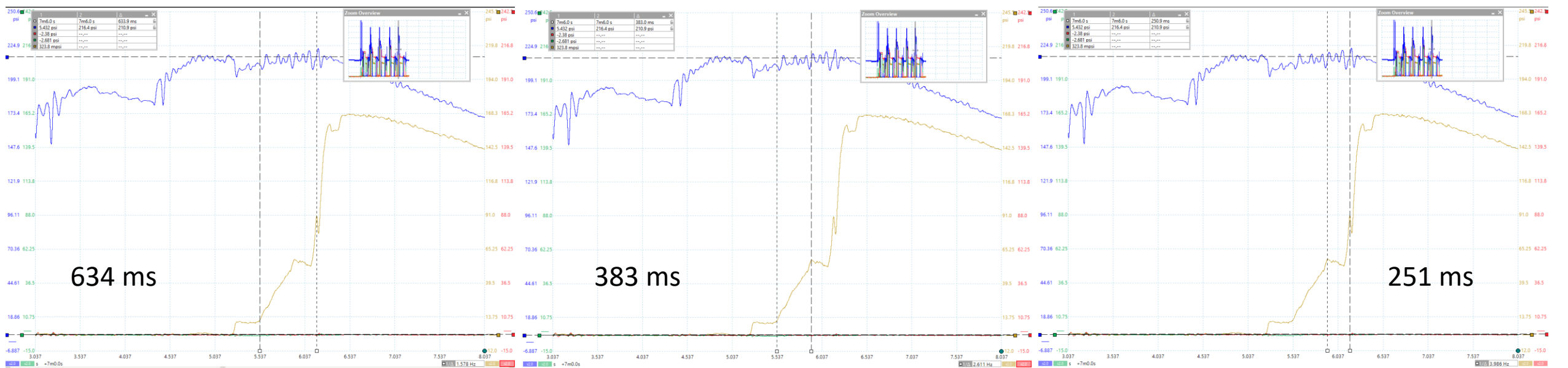
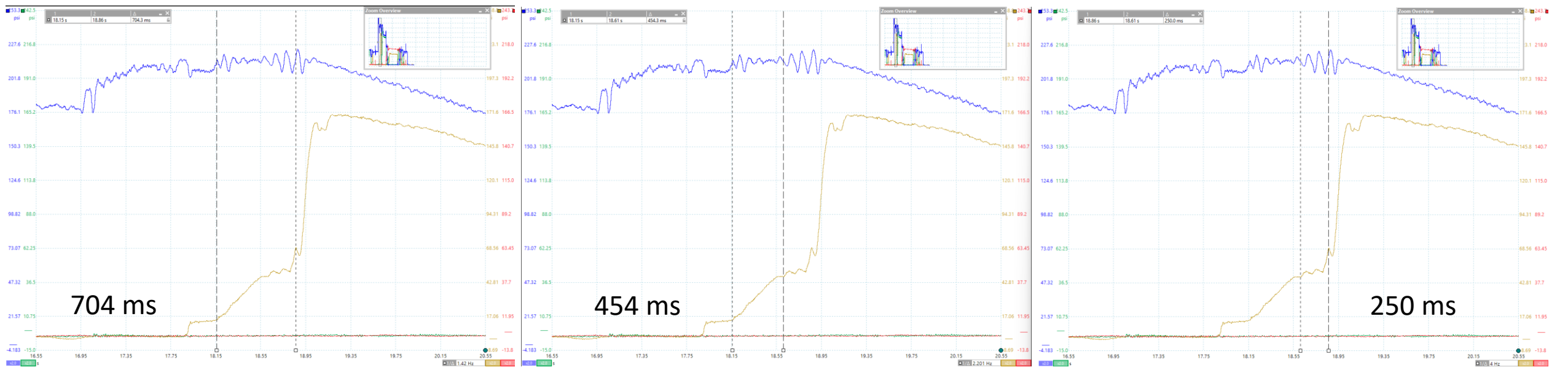
HP tuners – Torque Adder



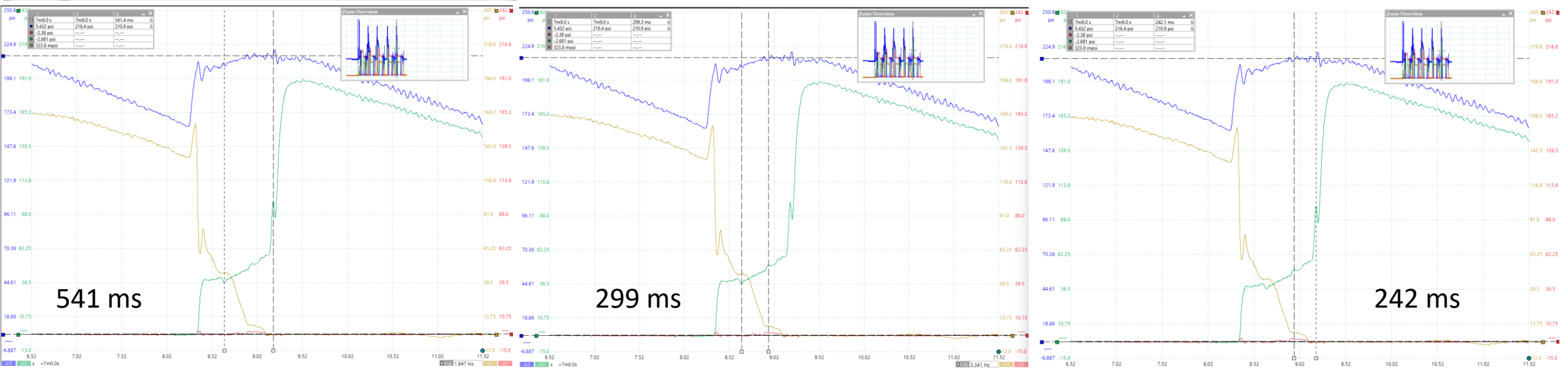
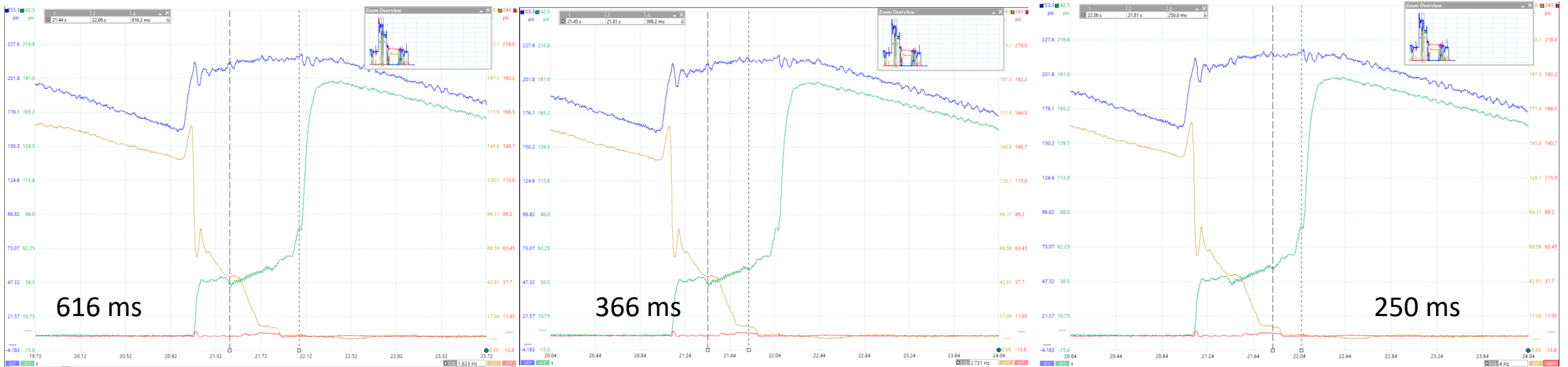
-30%



Decrease torque adder 30% - Baseline 1-2 vs Mod 1-2 shift



Decrease torque adder 30% at WOT throttle Baseline 2-3 vs Mod 2-3 shift



Decrease transition time 30%

- What is “Transition Time?”

- Decreasing this value changes the “inertia” time
- This also changes the total solenoid time
- Shift pressures mostly remain the same

The screenshots show the 'Inertia Factor' table for three different shift ranges:

- [TCM] 15761 - Shift Time Initial Transition Time % 1-2**

	1	2	3	4	5	6	7	8	9
Init Transition	0.0000	0.2803	0.2100	0.2100	0.2100	0.1572	0.1572	0.1543	0.1543
- [TCM] 15762 - Shift Time Initial Transition Time % 2-3**

	1	2	3	4	5	6	7	8	9
Init Transition	0.0000	0.2100	0.1748	0.1748	0.1748	0.1572	0.1543	0.1543	0.1543
- [TCM] 15763 - Shift Time Initial Transition Time % 3-4**

	1	2	3	4	5	6	7	8	9
Init Transition	0.0000	0.2803	0.2803	0.2803	0.2451	0.2451	0.2275	0.2100	0.1055

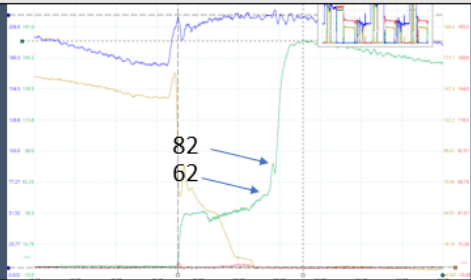
The screenshot shows the 'Transmission' software interface with the 'Transition Time' section highlighted by a red box. The interface includes tabs for 'General', 'Manual', and 'Shift General'. The 'Transition Time' section is divided into 'Initial - Normal', 'Initial - Special', 'Final - Normal', and 'Final - Special' categories, each with a grid of shift ranges (1-2, 2-3, 3-4, 4-5, 5-6, 1-3, 1-4, 2-4, 2-6, 3-5, 4-6).

[TCM] 15761 - Shift Time Initial Transition Time % 1-2: Percent of desired shift time to transition from

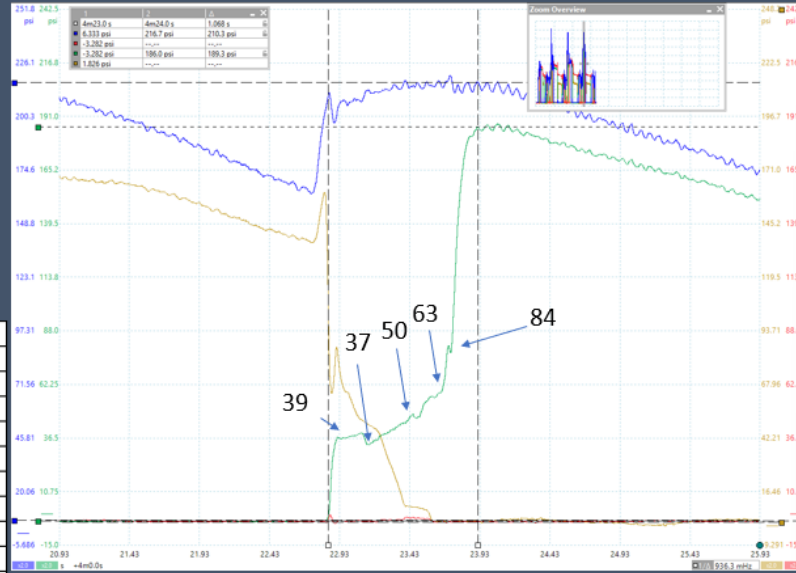
Decrease transition time 30%

Decrease upshift transition time 30% at WOT- Last 2-3 shift

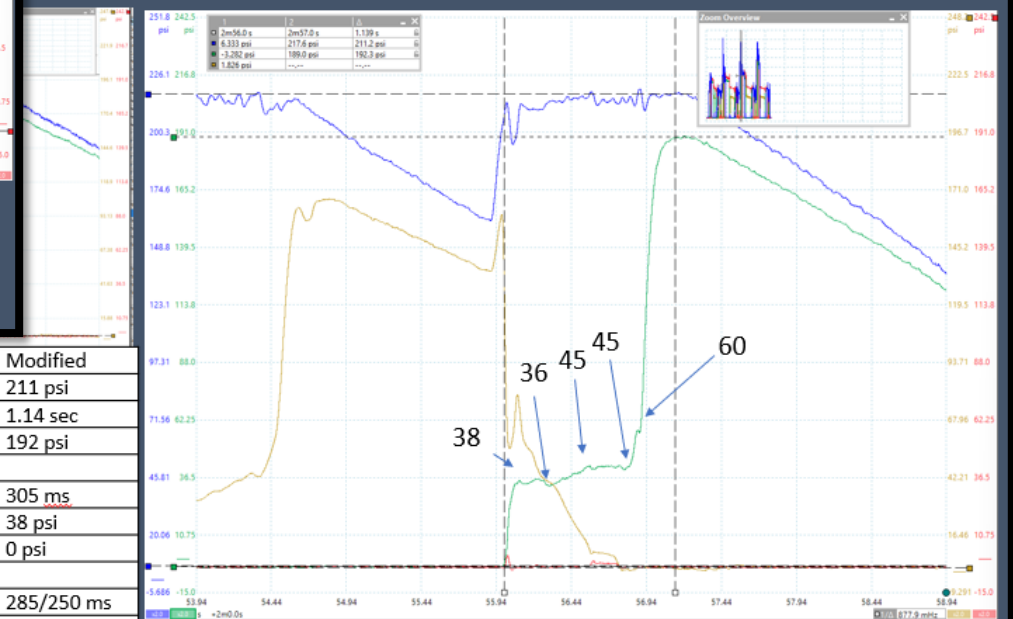
ALT BASELINE DUE TO THROTTLE MANAGEMENT



2-3 shift - Transition Time Mod	ALT Baseline	Modified
Line pressure	210 psi	210 psi
35R clutch press change	1.23 sec	1.07 sec
35R max pressure	188 psi	189 psi
Fill		
• 35R pressure change time	313 ms	282 ms
• 35R fill pressure	44 - 45 psi	39-42 psi
• 35R fill pressure change	1 psi	3 psi
Torque and Inertia phase		
• 35R pressure change time	618 ms	349/183 ms
• 35R inertia pressure	39 - 62 psi	37-50-63 psi
• 35R inertia pressure change	23 psi	26 psi
Final phase		
• 35R pressure change time	285 ms	256 ms
• 35R final pressure	78 - 188 psi	63 - 189 psi
• 35R final pressure change	110 psi	126 psi

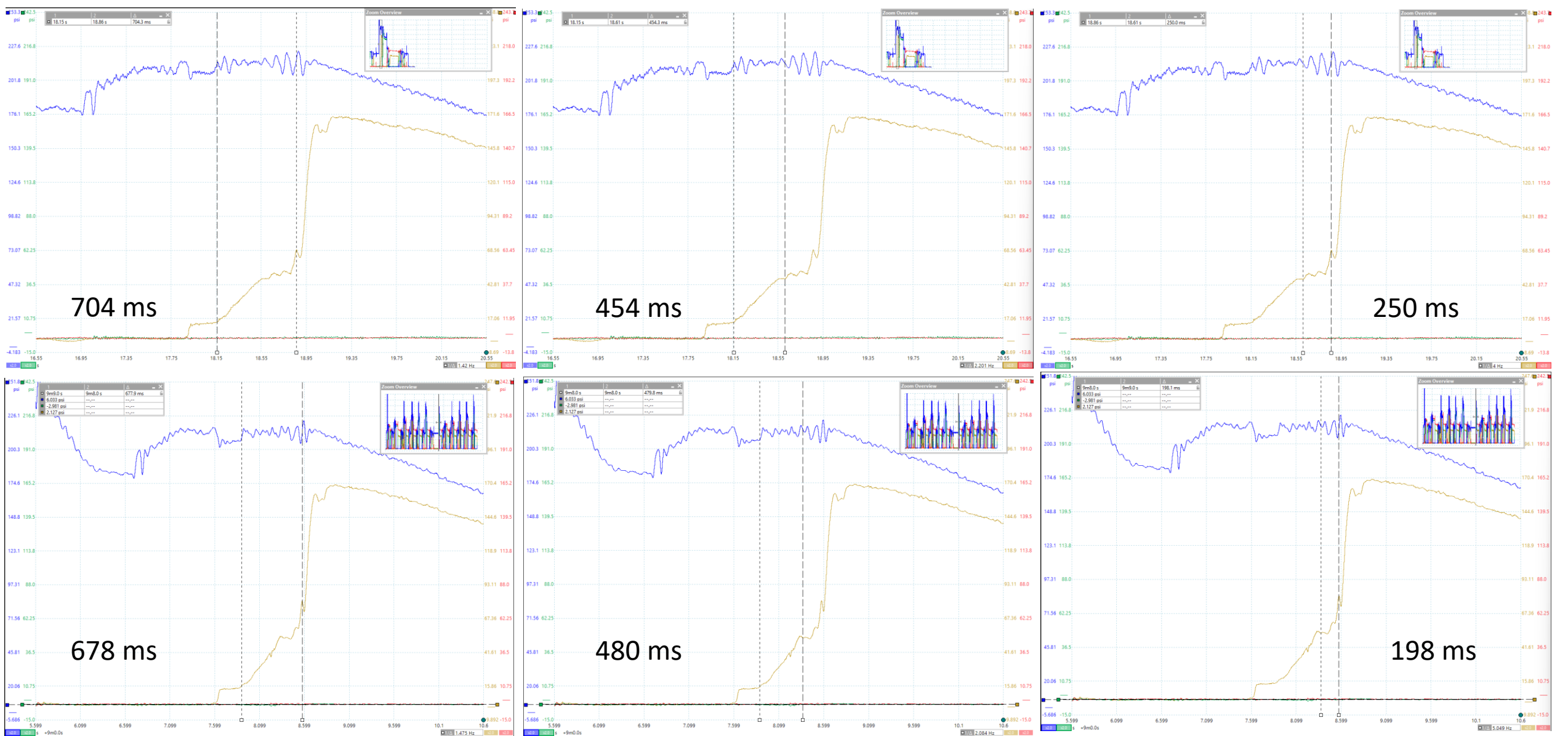


Decrease upshift transition time 30% at 40% -last 2-3 shift

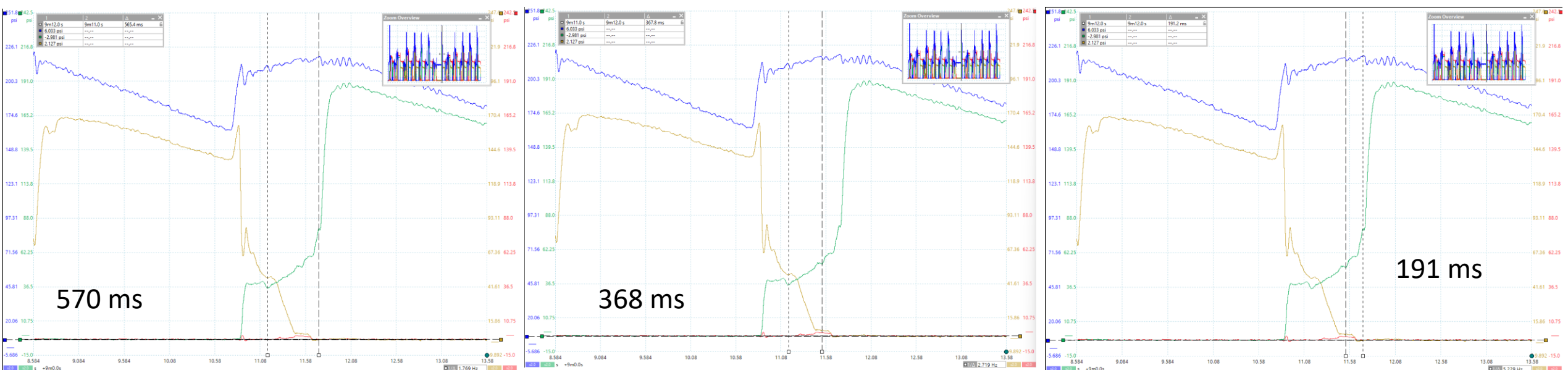
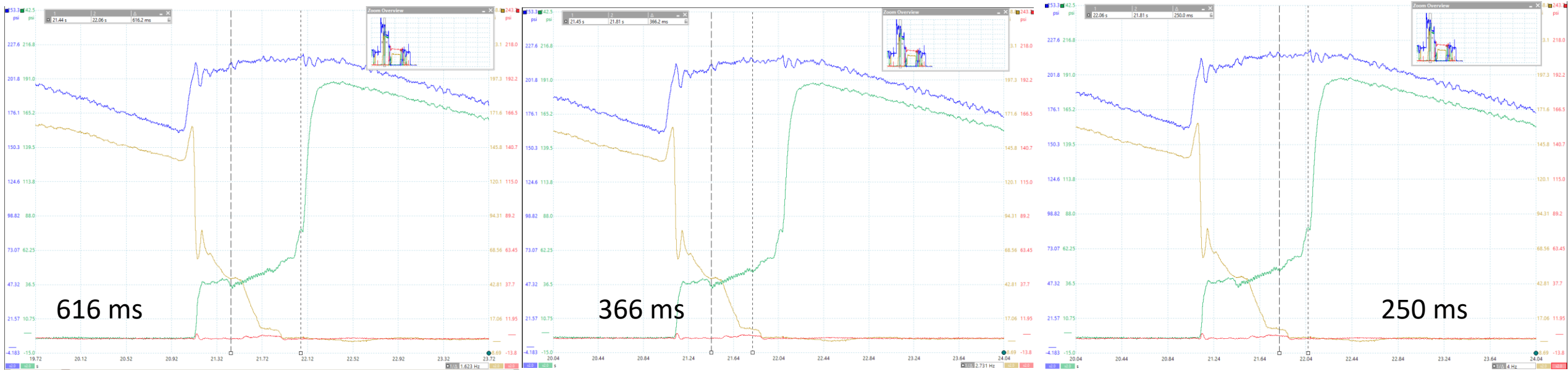


2-3 shift - Transition Time Mod	Baseline	Modified
Line pressure	212 psi	211 psi
35R clutch press change	1.28 sec	1.14 sec
35R max pressure	197 psi	192 psi
Fill		
• 35R pressure change time	334 ms	305 ms
• 35R fill pressure	37 - 41 psi	38 psi
• 35R fill pressure change	4 psi	0 psi
Torque and Inertia phase		
• 35R pressure change time	598 ms	285/250 ms
• 35R inertia pressure	38 - 41 psi	36-45-45 psi
• 35R inertia pressure change	3 psi	9 psi
Final phase		
• 35R pressure change time	306 ms	312 ms
• 35R final pressure	41 - 197 psi	45 - 192 psi
• 35R final pressure change	156 psi	147 psi

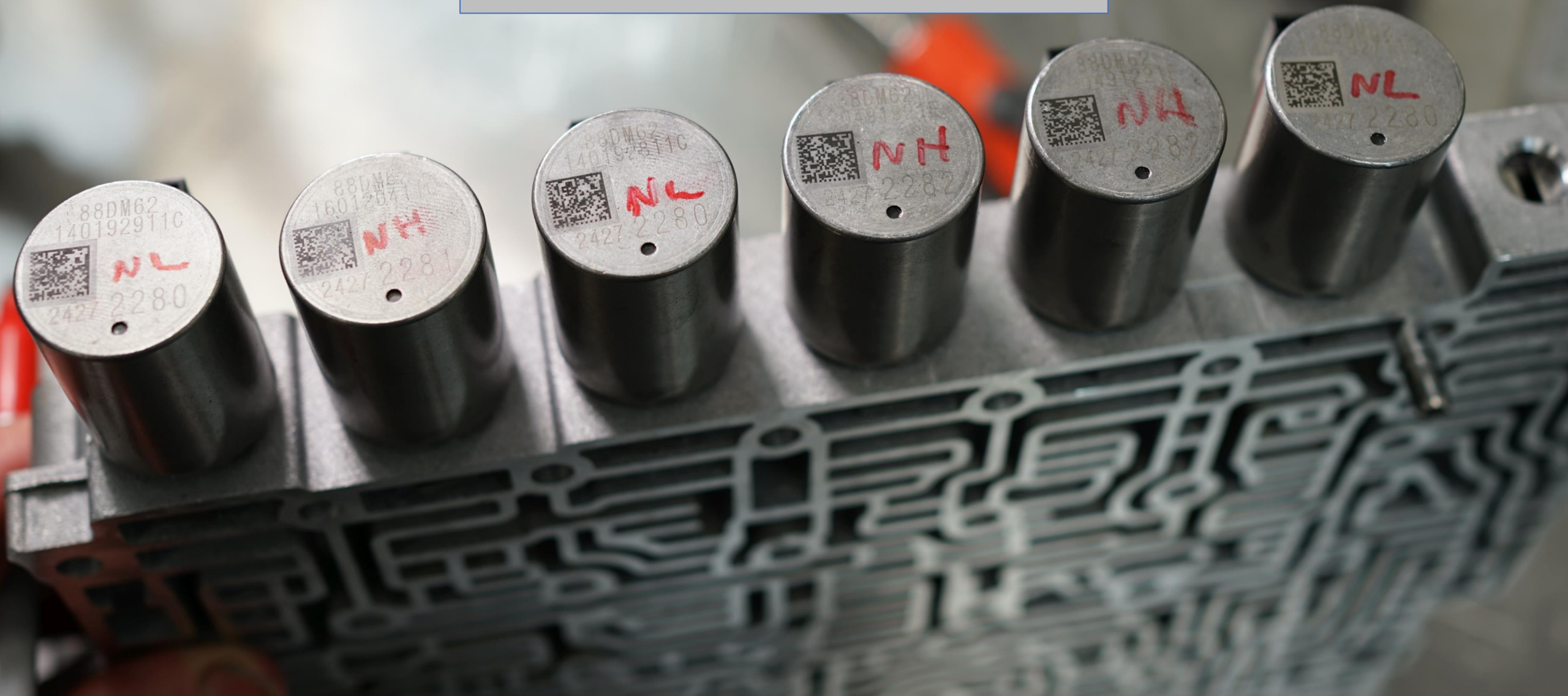
Decrease transition time 30% WOT throttle Baseline 1-2 vs Mod 1-2 shift



Decrease transition time 30% WOT throttle Baseline 2-3 vs Mod 2-3 shift

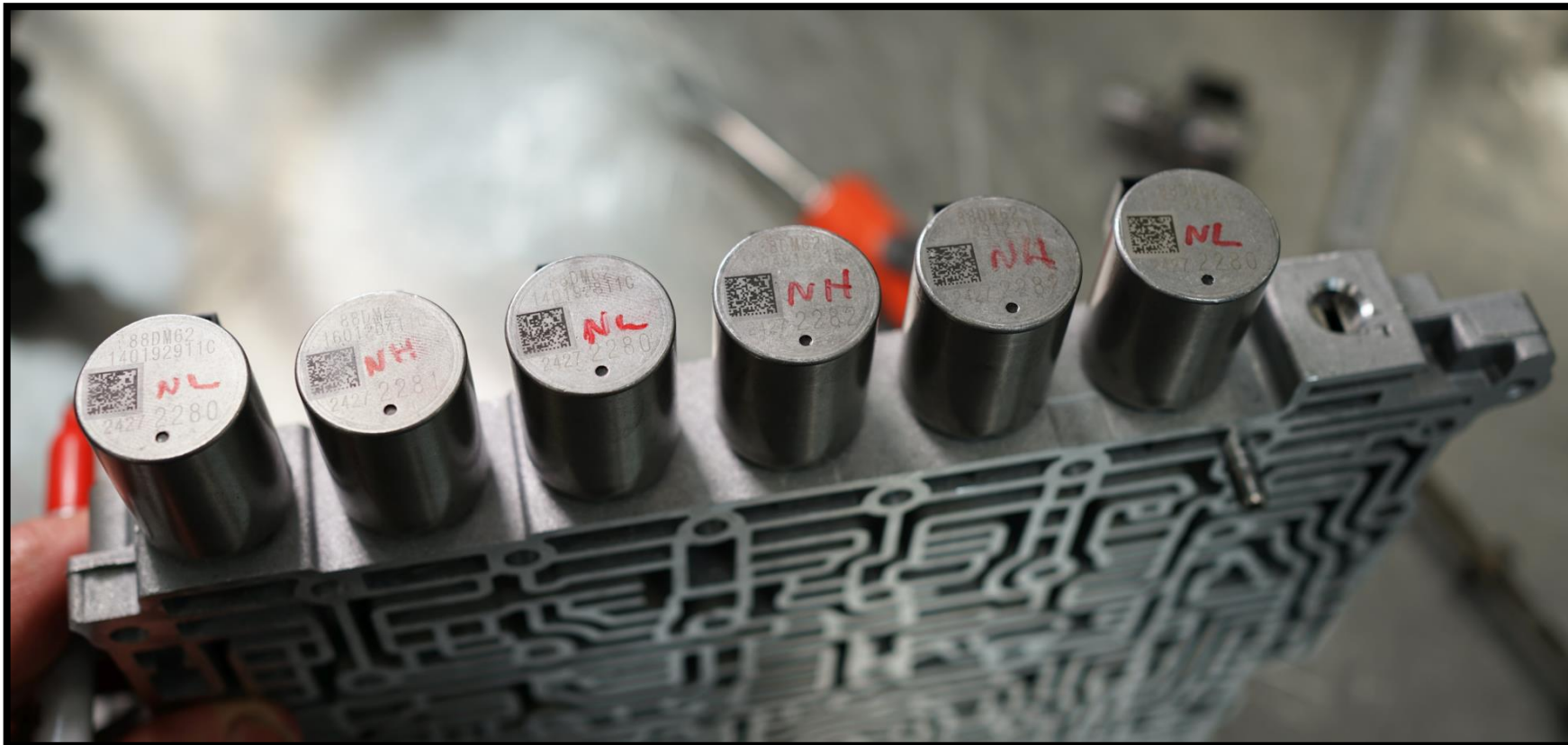


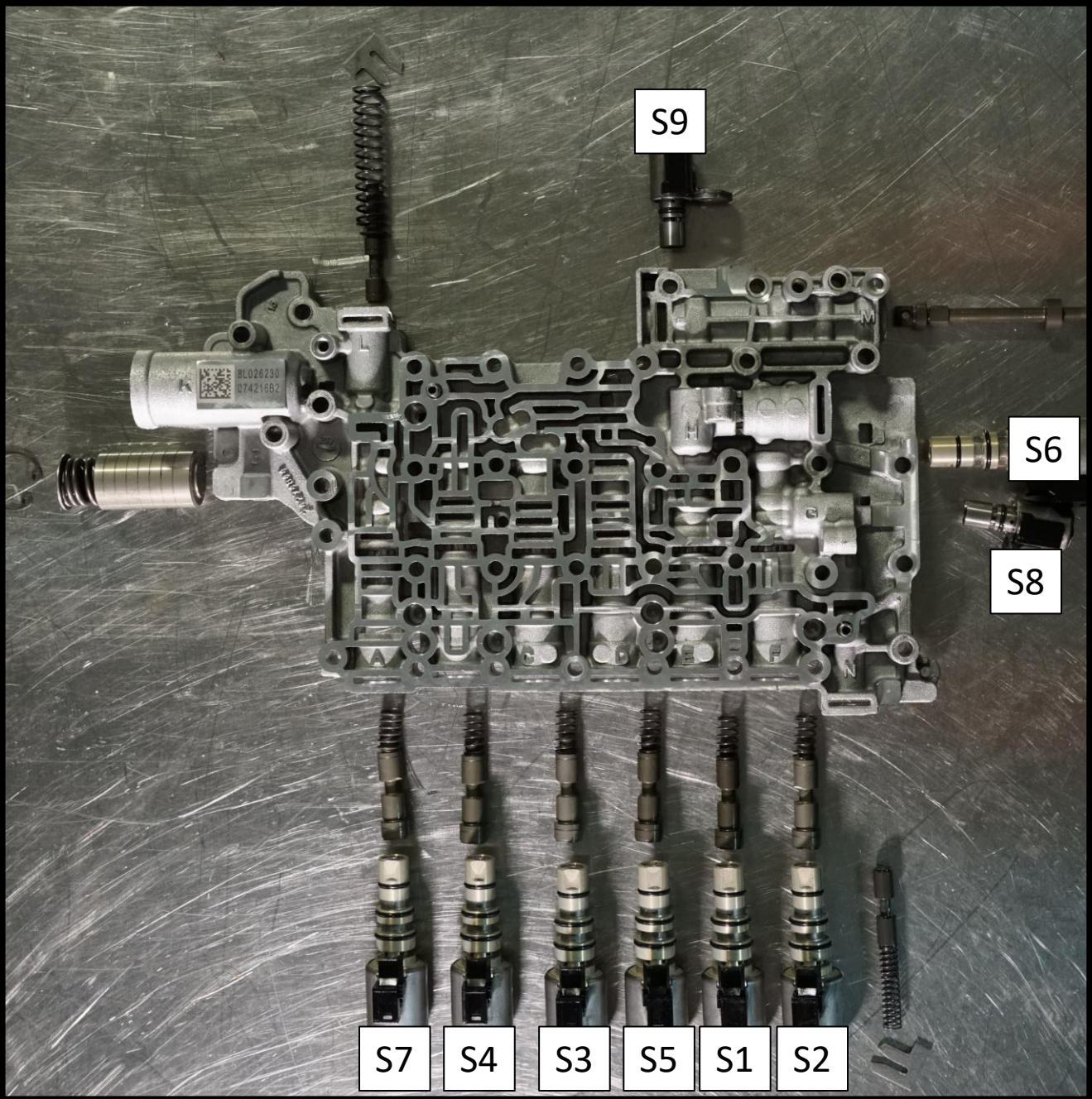
GM 8L90



Electronic Operation – Solenoids

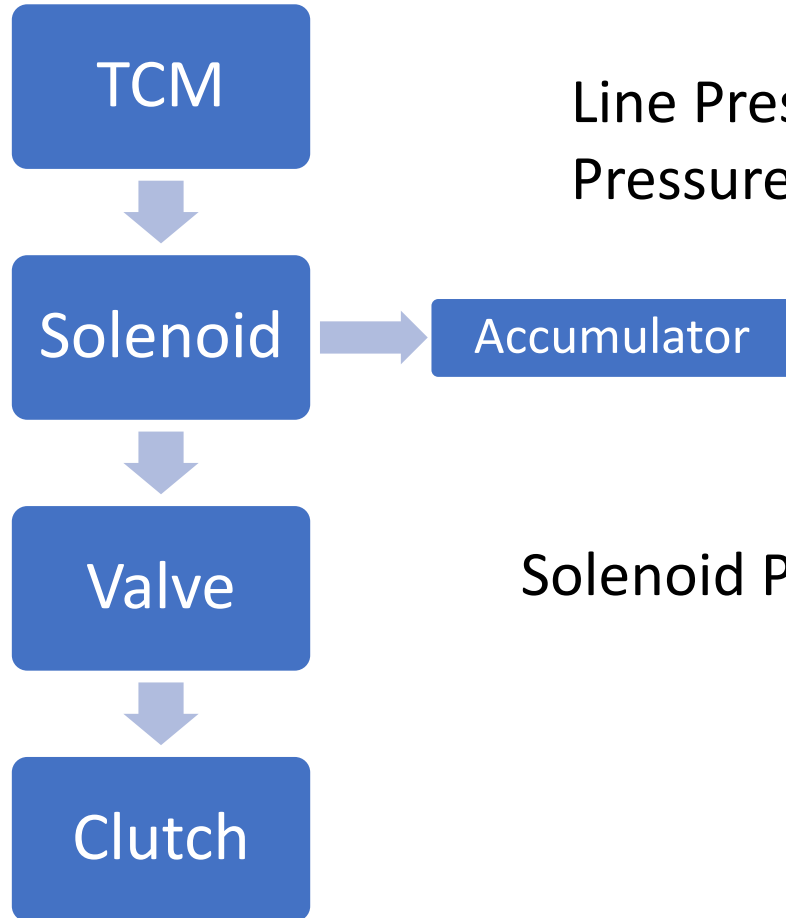
- PWM solenoids controlling pressure to valves, which control pressure to the clutches
- Clutch to clutch synchronization
- NL requires current to open and provide pressure
- NH requires no current to open and provide pressure





Sol ID	VB Label	Function	NH/ NL	AFL/ Line	Resistance
S1	E	1-2-7-8-R	NH	AFL	4.5-5.5 ohms
S2	F	1-2-3-4-5-R	NL	Line	4.5-5.5 ohms
S3	C	1-3-5-6-7	NL	Line	4.5-5.5 ohms
S4	B	2-3-4-6-8	NH	Line	4.5-5.5 ohms
S5	D	4-5-6-7-8-R	NH	AFL	4.5-5.5 ohms
S6	J	Line	NH	AFL	4.5-5.5 ohms
S7	A	TCC	NL	Line	4.5-5.5 ohms
S8	G	Default Control	NL	AFL	11-13 ohms
S9	H	1-2-3-4-5-R Boost	NL	AFL	11-13 ohms

Electronic Operation – Solenoids



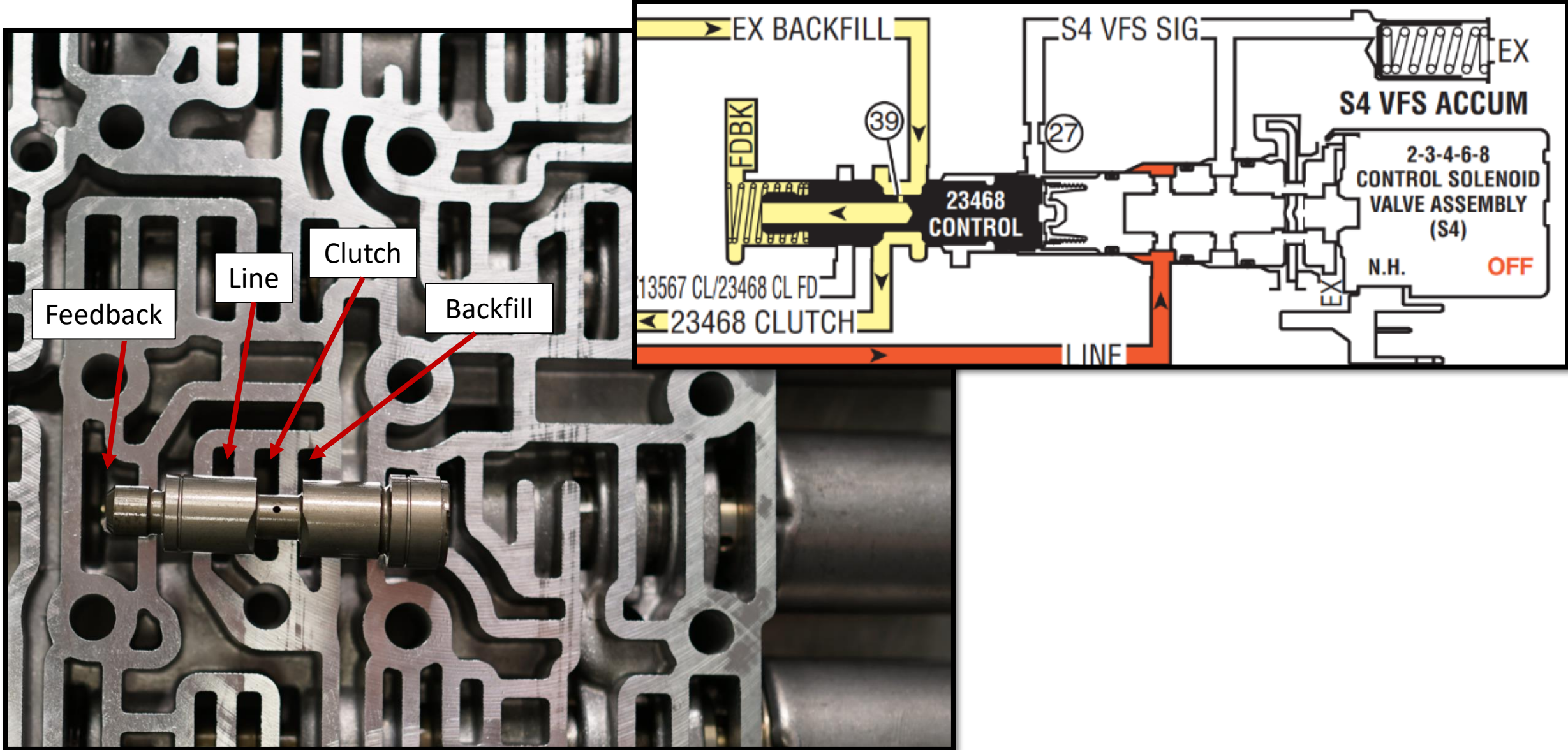
Line Pressure or Backfill Pressure to clutch

Solenoid Pressure OUT

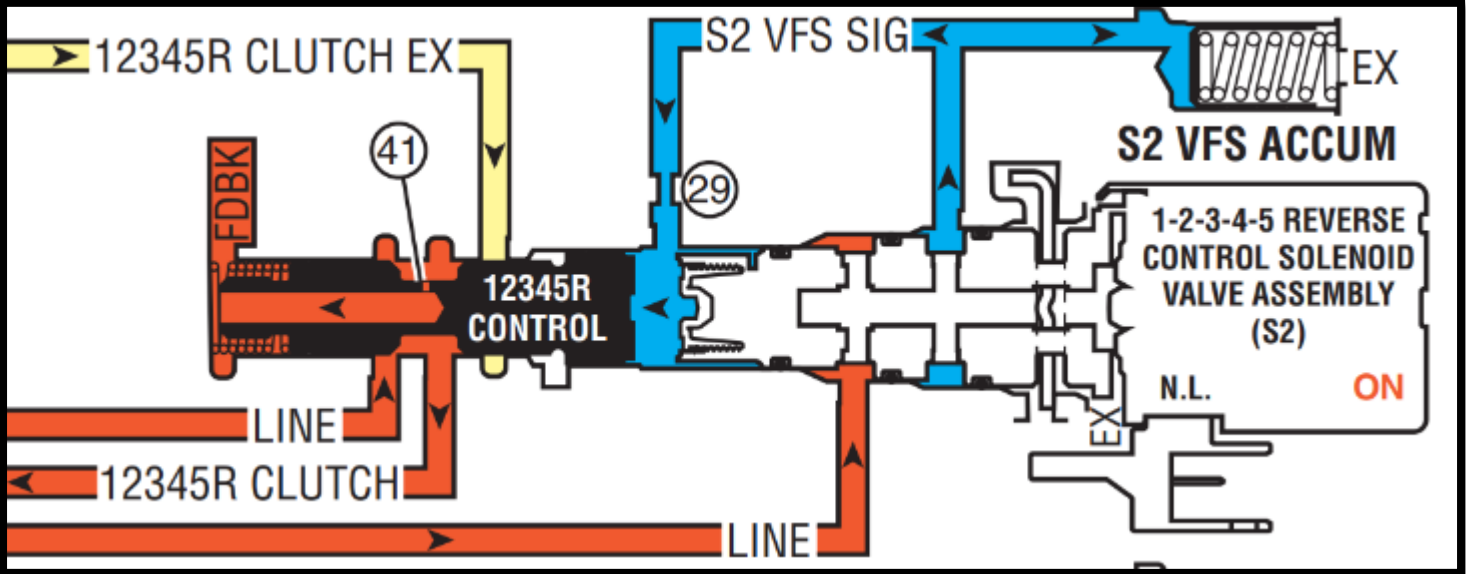
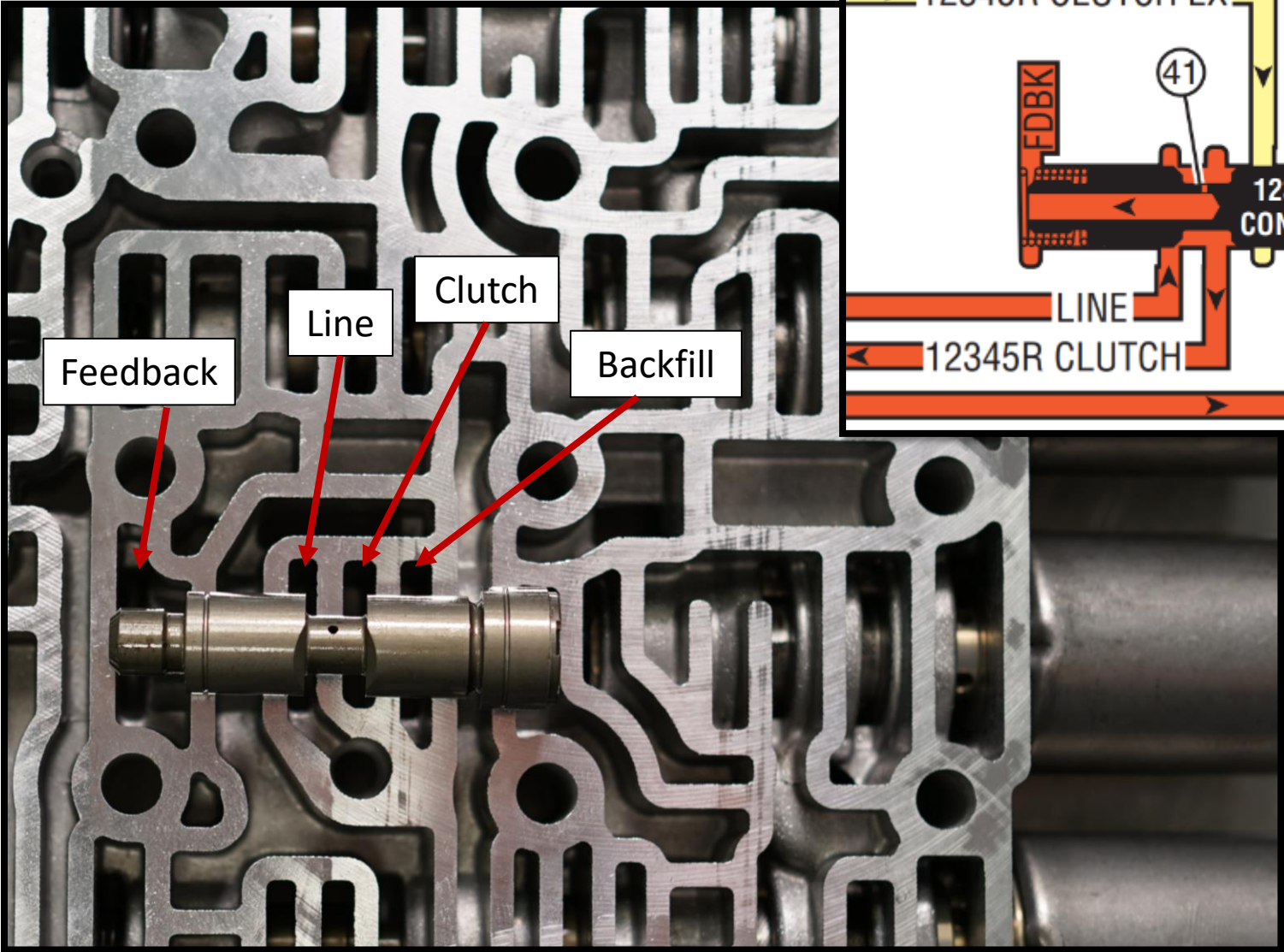
AFL or Line pressure IN



Hydraulic Operation – Clutch Control (clutch off)



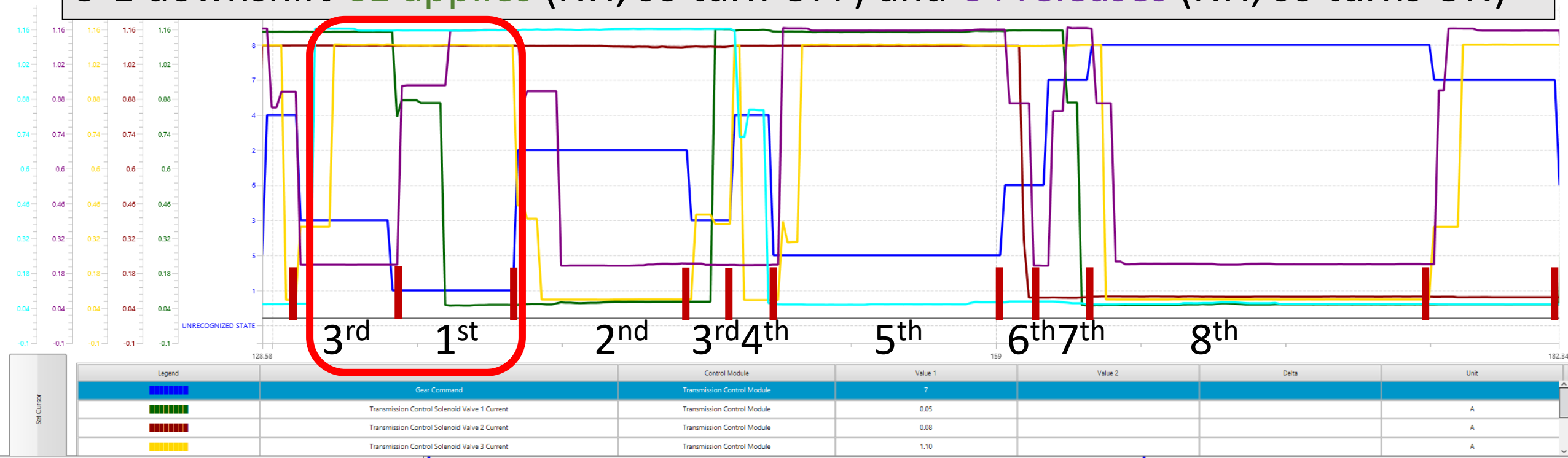
Hydraulic Operation – Clutch Control (clutch on)



Legend	Parameter Name
	Gear Command
	Transmission Control Solenoid Valve 1 Current
	Transmission Control Solenoid Valve 2 Current
	Transmission Control Solenoid Valve 3 Current
	Transmission Control Solenoid Valve 4 Current
	Transmission Control Solenoid Valve 5 Current

Sol ID	VB Label	Function	NH/NL	AFL/Line	Resistance
S1	E	1-2-7-8-R	NH	AFL	4.5-5.5 ohms
S2	F	1-2-3-4-5-R	NL	Line	4.5-5.5 ohms
S3	C	1-3-5-6-7	NL	Line	4.5-5.5 ohms
S4	B	2-3-4-6-8	NH	Line	4.5-5.5 ohms
S5	D	4-5-6-7-8-R	NH	AFL	4.5-5.5 ohms

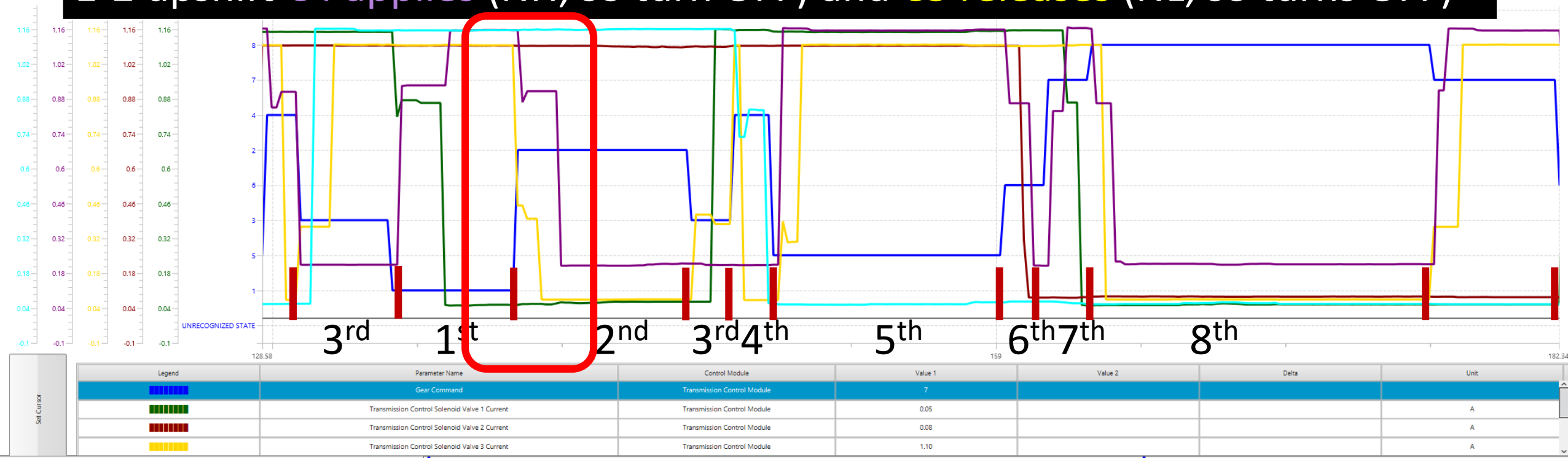
3-1 downshift C1 applies (NH, so turn OFF) and C4 releases (NH, so turns ON)



Legend	Parameter Name
	Gear Command
	Transmission Control Solenoid Valve 1 Current
	Transmission Control Solenoid Valve 2 Current
	Transmission Control Solenoid Valve 3 Current
	Transmission Control Solenoid Valve 4 Current
	Transmission Control Solenoid Valve 5 Current

Sol ID	VB Label	Function	NH/NL	AFL/Line	Resistance
S1	E	1-2-7-8-R	NH	AFL	4.5-5.5 ohms
S2	F	1-2-3-4-5-R	NL	Line	4.5-5.5 ohms
S3	C	1-3-5-6-7	NL	Line	4.5-5.5 ohms
S4	B	2-3-4-6-8	NH	Line	4.5-5.5 ohms
S5	D	4-5-6-7-8-R	NH	AFL	4.5-5.5 ohms

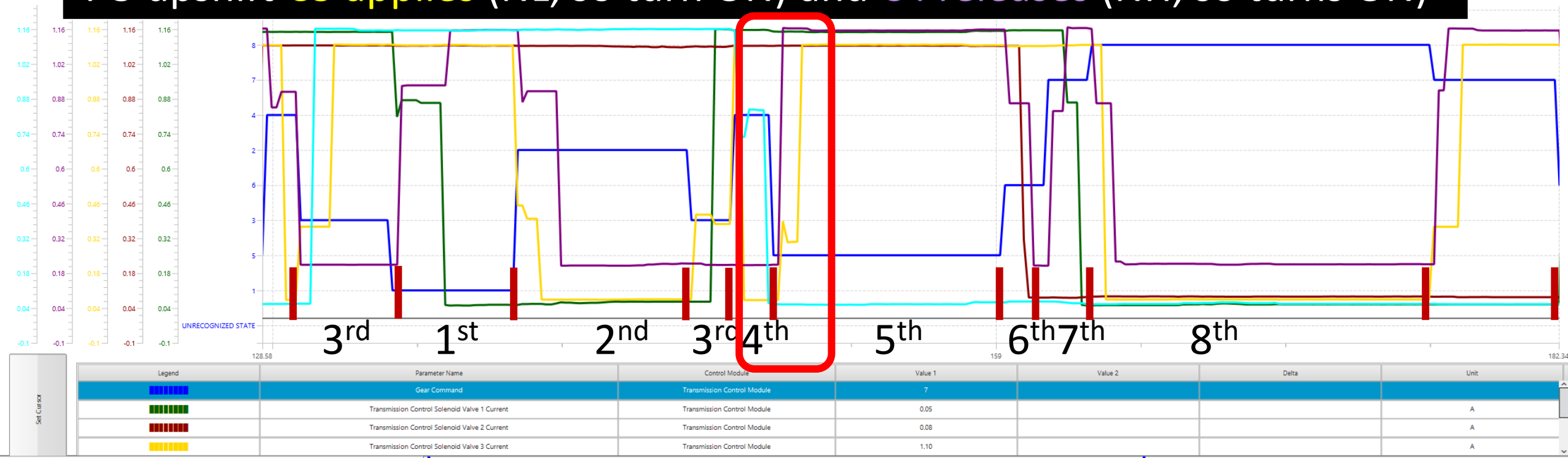
1-2 upshift C4 applies (NH, so turn OFF) and C3 releases (NL, so turns OFF)



Legend	Parameter Name
	Gear Command
	Transmission Control Solenoid Valve 1 Current
	Transmission Control Solenoid Valve 2 Current
	Transmission Control Solenoid Valve 3 Current
	Transmission Control Solenoid Valve 4 Current
	Transmission Control Solenoid Valve 5 Current

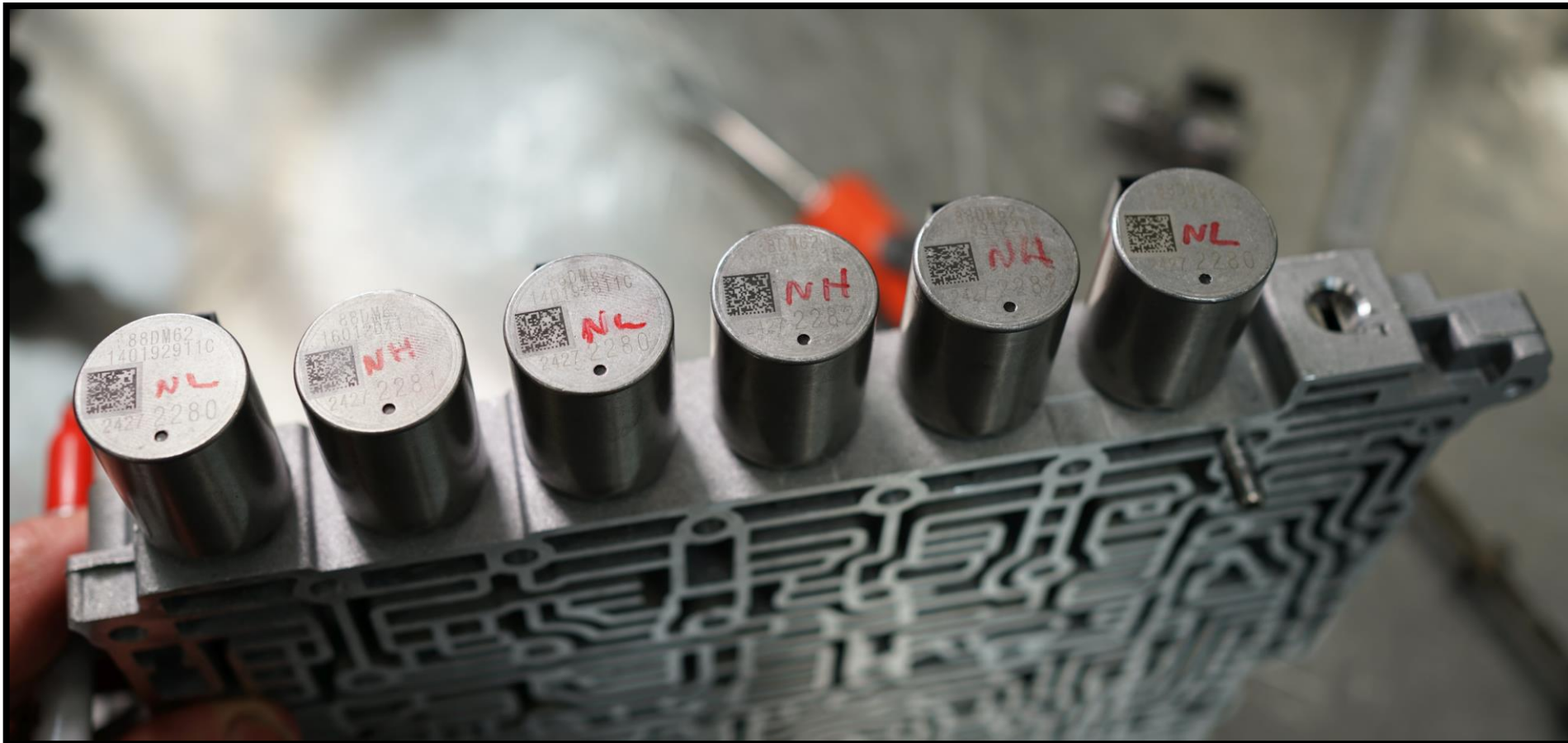
Sol ID	VB Label	Function	NH/NL	AFL/Line	Resistance
S1	E	1-2-7-8-R	NH	AFL	4.5-5.5 ohms
S2	F	1-2-3-4-5-R	NL	Line	4.5-5.5 ohms
S3	C	1-3-5-6-7	NL	Line	4.5-5.5 ohms
S4	B	2-3-4-6-8	NH	Line	4.5-5.5 ohms
S5	D	4-5-6-7-8-R	NH	AFL	4.5-5.5 ohms

4-5 upshift **C3 applies** (NL, so turn ON) and **C4 releases** (NH, so turns ON)



Electronic Operation – Solenoids

- TCM controls clutch feel and clutch apply through solenoid PWM
- TCM learns the solenoid and VB characteristics through Transmission Unique Number (TUN) and Part Unique Number (PUN) programming



Electronic Operation – Solenoids



Data List: Identification Information

Date Programmed	20170111
Diagnostic Data Identifier	0
End Model Part Number	24286912
Base Model Part Number	24269492
Software Module 1 Identifier	24286913
Software Module 1 Identifier Alpha Code	AA
Software Module 2 Identifier	24287042
Software Module 2 Identifier Alpha Code	AC
Software Module 3 Identifier	24283176
Software Module 3 Identifier Alpha Code	AF
Software Module 4 Identifier	24283178
Software Module 4 Identifier Alpha Code	AF
Software Module 9 Identifier	24272181
Software Module 10 Identifier	24274482
System Code	0
Number of Calibration History Events Stored	10
Calibration Verification Number History 1	F4D8
Calibration Verification Number History 2	FFFF
Calibration Verification Number History 3	FFFF
Calibration Verification Number History 4	FFFF
Calibration Verification Number History 5	FFFF
Calibration Verification Number History 6	FFFF
Calibration Verification Number History 7	FFFF

Electronic Operation – TCM

- External TCM – trucks are by the brake booster
- Some are by the headlight assembly (notorious)
- Check for updates to the programming!

Data List: Identification Information

Date Programmed	20170111
Diagnostic Data Identifier	0
End Model Part Number	24286912
Base Model Part Number	24269492
Software Module 1 Identifier	24286913
Software Module 1 Identifier Alpha Code	AA
Software Module 2 Identifier	24287042
Software Module 2 Identifier Alpha Code	AC
Software Module 3 Identifier	24283176
Software Module 3 Identifier Alpha Code	AF
Software Module 4 Identifier	24283178
Software Module 4 Identifier Alpha Code	AF
Software Module 9 Identifier	24272181
Software Module 10 Identifier	24274482
System Code	0
Number of Calibration History Events Stored	10
Calibration Verification Number History 1	F4D8
Calibration Verification Number History 2	FFFF
Calibration Verification Number History 3	FFFF
Calibration Verification Number History 4	FFFF
Calibration Verification Number History 5	FFFF
Calibration Verification Number History 6	FFFF
Calibration Verification Number History 7	FFFF

gm calibration id - Search

https://tis2web.service.gm.com/tis2web/?target=A1Y835G83Y793&target.method=on...

SPS Info

To obtain the latest electronic controller calibration information for your vehicle, enter the vehicle's 17 character Vehicle Identification Number (VIN) and select 'Get CAL ID'.

To obtain the Calibration Verification Number (CVN) for any calibration part number, enter the part number of the calibration ID and select 'Get CVN'.

VIN: Part Number:

ACDelco

Subscriptions Keycodes My Orders Store Resources

Sean Boyle

TECHNICAL DELIVERY SYSTEM

ACDelco Technical Delivery System is General Motors' service information, diagnosis, programming portal to the automotive aftermarket. We share a common goal with you: to provide the best services possible to our customers. The offerings available through this portal are designed to meet your varied business needs.

- ACDelco Training
- GM Service Information Library
- System Requirements
- GM Tech Info
- Diagnostic Scan Tool
- SPS Calibration Information**
- GM Dealer Equipment
- GM Special Tools

SUBSCRIPTIONS

Accurate and efficient vehicle diagnosis and repair is a corner stone for any vehicle. Technical Delivery System has multiple subscription offerings to fit your service and diagnostic vehicle repair needs. Service information gives you access to all documentation for repairing General Motors' manufactured vehicles. Diagnostics enable you to communicate with General Motors vehicles. Service programming enables you to download and update module calibrations. To assure proper software functionality, please assure your computer hardware meets our [system requirements](#).

GENERAL MOTORS

SPS Information

To obtain the latest electronic controller calibration information for your vehicle, enter the vehicle's 17 character Vehicle Identification Number (VIN) and select 'Get CAL ID'

To obtain the Calibration Verification Number (CVN) for any calibration part number, enter the part number of the calibration ID and select 'Get CVN'

You will be required to answer a captcha on your first search, afterwards you will be prompted to answer every 5th search

VIN Part Number

<https://acdelcotds.com> (set up a free account)

<https://tis2web.service.opel.com/tis2web/>



1/24



Used

2020 Chevrolet Silverado 1500 LT

61,844 mi.

\$35,900

Save

Opel/Vauxhall Vehicle Calibration Information

VIN:	3GCPWCED0LG286913
Controller:	K71 Transmission Control Module
Function:	Programming
Programming Type:	Normal
Transmission:	With 8 SPD Automatic Transmission (RPO MQE)

Calibration History for: Operating system

Part Number	CVN	Bulletin #	Description
24044054	0000B96D	-	Updated Operating System
24294249	00001E0F	-	Operating system

Calibration History for: Transmission

Part Number	CVN	Bulletin #	Description
24044237	0000E3B3	-	Update Transmission to address a potential loss of propulsion and DTC P0707, P0708 and P2805
24299556	00000F8C	-	Transmission Update to improve shift quality
24291000	0000F1B0	-	Transmission

www.acdelcotds.com

<https://tis2web.service.opel.com/tis2web/>

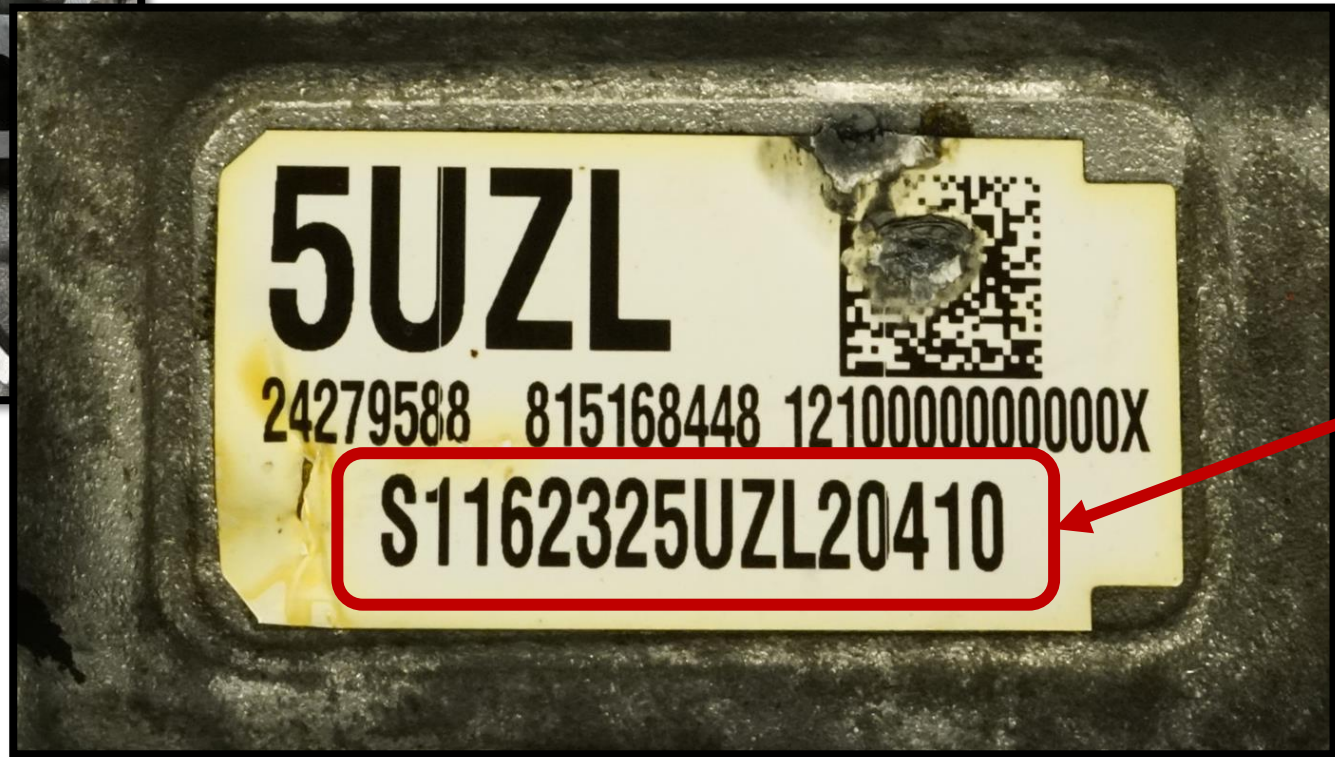
Electronic Operation – TUN/PUN

- When installing a new valve body or transmission, the TCM will prompt for the Transmission Unique Number (TUN) and the valve body unique number (PUN) in order to reference the proper calibration files
- Replacing a transmission will likely only require the TUN (outside of trans case)
- Replacing the VB will likely require the PUN
- Program the TUN and PUN using a capable pass-through device
- Perform Fast Learn and clutch adapts after any overhaul or part replacement that will affect shift quality

Electronic Operation – TUN/PUN



PUN



TUN

Fast learn and clutch adapts

- Fast learn clears adapts
- Individual clutch learns allow for quicker adaptation
- Perform individual clutch adaptations after fast learn when some shifts aren't satisfactory
- Adaption after 5000 miles might temporarily improve the shift, but it will likely revert back

		C3	C5	C4	C1	C2
RANGE	GEAR	1-3-5-6-7 CLUTCH	4-5-6-7-8 REVERSE CLUTCH	2-3-4-6-8 CLUTCH	1-2-7-8 REVERSE CLUTCH	1-2-3-4-5 REVERSE CLUTCH
PARK	P				APPLIED**	APPLIED**
REV	R		APPLIED		APPLIED	APPLIED
NEU	N				APPLIED**	APPLIED**
D	1st	APPLIED			APPLIED	APPLIED
	2nd			APPLIED	APPLIED	APPLIED
	3rd	APPLIED		APPLIED		APPLIED
	4th		APPLIED	APPLIED		APPLIED
	5th	APPLIED	APPLIED			APPLIED
	6th	APPLIED	APPLIED	APPLIED		
	7th	APPLIED	APPLIED		APPLIED	
	8th		APPLIED	APPLIED	APPLIED	

Shift	Applying Clutch	Releasing Clutch
1-2	C4	C3
2-3	C3	C1
3-4	C5	C3
4-5	C3	C4
5-6	C4	C2
6-7	C1	C4
7-8	C4	C3
3-1	C1	C4
2-1	C3	C4
N-D	C3	
N-R	C5	

Fast learn and clutch adapts

Vehicle warmed up and trans temp between 165 and 187 degrees

Clutch	Shifts	Pressure learn	Volume learn	Notes
C1	6-7, 3-1	30-45mph, 6 th gear in manual range, 1000-1600 rpm, 5 miles	15 light throttle 6-7 shifts at 15% throttle	Cruise control is helpful in faster learning of pressure learn
C2	6-5	40-45mph, 10 normal 6-5 coast downshifts	8 th gear in manual range, 1000-1750 rpm, 5 miles	Cruise control is helpful in faster learning of volume learn
C3	2-3, 4-5, N-D	10 normal 8-7 downshifts	15 light throttle 2-3 upshifts at 15% throttle	RPO M5X and certain Silverados - 15% throttle through the 7-8 upshift must be performed prior to each downshift. This action enables torque converter clutch (TCC) controlled slip on downshift to occur vs. TCC unlocked, which occurs on normal downshifts and disables Adaptive Learn.

Fast learn and clutch adapts

Clutch	Shifts	Pressure learn	Volume learn	Notes
C4	1-2, 5-6, 7-8	40-45mph, 7 th gear in manual range, 1000-1750 rpm, 5 miles	15 light throttle 1-2 shifts at 15% throttle	Cruise control is helpful in faster learning of volume learn. Certain Express & Savana vans - Perform ten 7-6 coast down shifts to complete pressure learns
C5		5 - 25mph, 3rd gear in manual range, slow acceleration starting at 1000rpm, maintain until 2500rpm, slow down to 1000rpm and repeat 10 times	15 light throttle 3-4 shifts at 15% throttle	Business park or low speed area for pressure learn
Power DS	8-7, 7-6, 6-5, 5-4, 4-3, 3-2, 2-1	8 th gear, apply throttle until downshift occurs, repeat for each gear		
Garage	N-D, N-R	Learn C3/C5 as indicated above first. With vehicle at stop, hold foot on brake, shift N-D/N-R, release brake and roll 5 – 10 feet. Repeat as necessary.		

Bulletins

Bulletin ID	Complaint	Correction	Vehicles
19-NA-244	Harsh 3-2 Downshift Coast down	Reprogram	2019 Trucks
16-NA-019	Adaptive Shift	Information on how to update shift adapts to correct for poor shifts	All vehicles
20-NA-102	Lack of Accel followed by clunk shifting from Rev to Drive	No correction, information on coming to complete stop before shifting between ranges	2019 Trucks
20-NA-187	Delayed and/or Harsh engagement of shift after vehicle sitting	No correction, information that it might take 3 seconds. If it takes longer, then perform an adaptive learn of the C3 and C5 clutches. If that doesn't help, then disassemble and inspect seals and look for damage	Most vehicles 2018 to current
16-NA-361	Harsh 1-2 shift first shift of the day	No correction.	Most vehicles 2015 to current
19-NA-035	Park does not engage	Damaged park pawl or actuator.	Most vehicles 2015 to current

Bulletins

Bulletin ID	Complaint	Correction	Vehicles
18-NA-227	New Model Feature	Bulletin covering the differences in the 2019 trucks, including the “centrifugal pendulum absorber (CPA),” dynamic fuel management (17 cylinder patterns), resonance free exhaust pipe with mesh integrated into the exhaust.	2019 trucks
18-NA-355	Shake/Shudder between 25-80mph	Diagnose vibration with a scope to verify that it is a TCC shudder. If it is, do a fluid exchange with updated fluid	All vehicles
PIP5700A	Internal harness	Internal harness part numbers	Most vehicles 2015 to current
PIP5741	No Movement after VB replacement	A plug and retaining bolt might be missing on the replacement VB.	2015 to 2018 vehicles
PIP5659	Turbine shaft seal differences	Front turbine shaft and rear stator support shaft seals have changed, and seal installation cannot be performed with earlier tools.	2019 to current

Bulletins

Bulletin ID	Complaint	Correction	Vehicles
16-NA-213	Harsh shifts after mileage accumulation	Replace VB after diagnostics are followed	2015 -2016 models
16-NA-014	Delayed engagement after sitting	If due to converter drainback, install a new stator support assembly, which contains an additional checkball	2015 -2016 models
15-NA-007	Firm garage shifts, clunk, dtc P16f3	Reprogram	2015 - -2016 models
15-07-30-002A	Firm shifts, shudder, flare, P0606, P16f3, P2818	Reprogram	2015
19-NA-142	Fluid exchanged	Transmissions manufactured before Feb 1, 2019 need the fluid exchanged	2015 to 2019
16-NA-411	Harsh 1-2, Harsh 3-1, step in clunk	Reprogram	2015 - 2016

Bulletins

Bulletin ID	Complaint	Correction	Vehicles
16-NA-404	Harsh shift, delayed shift, unwanted DS, stuck in gear, erratic shift, hesitation, P0747, P0777, P0797, P2715, P2724	Reprogram	2017
N192291660	Internal harness failure	Increases coverage to 10 years, 120,000 miles	2016
PIP5678	Cannot perform TUN characterization	Some VINs are locked out by GM due to fluid contamination issue. Contact TAC	2015 - 2017
15-NA-083	Recovery process from programming interruption	Turn off ign, global battery reset for 5 min, reconnect battery, rerun SPS, if fails, disconnect TCM for 5 minutes, rerun SPS	2015 - 2016
14-07-30-001	Adaptive process for Vette	This bulletin defines the procedure for updating the clutch adapts for the vette	2015 vette

Test clutches with regulated
air pressure (30 psi)

1-3-5-6-7 (C3)

4-5-6-7-8-R

2-3-4-6-8 (C4)

To Cooler

From Cooler

1-2-7-8-R (C1)

1-2-3-4-5-R (C2)

Line

