RevUp - Smarter Solutions for Faster Repairs!

Presents:

"Mastering Modern Diagnostic Strategy"

DORMAN TRAINING CENTER | Motor Age TRAINING

2026

Your Instructor For This Webinar

- National Trainer, ASE World Class, Master Auto, Truck, School Bus, L1, L3, CNG
- ATTP Master Instructor, New York State, CT and New Jersey
- STS (Service Technician Society) 2003 President
- TST (Technicians Service Training) Founder and President
- Author / Co Author/ Technical adviser on 25 plus books including
- OBD II and Mode 6, and Understanding and Diagnosing Hybrid Vehicles
- Published articles for multiple newsletters, and magazines
- Picked as one of the Top Instructors in the country by EPA & SAE
- Numerous Radio, TV, Internet, and SAE Video appearances
- PTEN, Motor Age and TST Webcast Instructor - Dorman Training Director
- Motor Magazine Top 20 award winner
- Provider of OBD II Training for 14 states, Ontario Canada and the US EPA
- Guest speaker at SAE Congress, IM Solutions and Clean Air Conference

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What Will Be Covered

Instructions for this webinar

- This seminar will be approx. 2 hours long
- All slides that are presented are in your handout and are numbered
- Have a pen or pencil and paper for notes
- Questions can be asked at anytime

01 3-step diagnostic process

02 Building a diagnostic plan

03 Using all 10 modes of Global OBD-II

04 No code diagnostic strategies

05 Case studies

Building The Diagnostic Game Plan

Special Tip #1 - The First Three Diagnostic Steps

- Step 1: Verify the concern
  - You can't fix it if you can't duplicate it
  - Intermittents are faults where you haven't figured out yet what the circumstances are that result in the concern showing itself
- Step 2: Check the system for trouble codes
  - Perform a full system scan
- Step 3: What do you think the third step is?
  (Hint: It's a commonly forgotten step!)
  - Check for Technical Service Bulletins!

Special Tip #2 - Only Four Things Can Make An Engine Run Bad

- Engine mechanical - the ability of the engine to seal and compress the air/fuel mixture
- Volumetric efficiency - the ability to move air in and out of the engine noted as a percentage of actual airflow versus theoretical airflow (what it did move versus how much it should have moved)
- Ignition - the ability to provide a good, continuous spark at the right time
- Fuel - the ability to deliver the precise quantity of fuel at the right time and in the proper atomization

Diagnostic Path - Which Funnel Should I Be In

8 Steps of Diagnostics

1 - Verify the customer concern

2 - Perform visual inspection and simple tests

3 - Retrieve diagnostic trouble codes

4 - Check for TSB's

5 - Look at scan tool data

6 - Narrow problem down to system or cylinder

7 - Find root cause and perform repair

8 - Confirm repair before giving customer vehicle back

Build Your Diagnostic Worksheet - Test Before You Swap Parts

- Battery, starting and charging
- Pre-scan report
- Review pre-scan tool data (enhanced and generic)
- Time to temperature
- Pre-5 gas analysis (extra credit)
- Engine mechanical

Build Your Diagnostic Worksheet

- Ignition system
- Fuel delivery system (extra credit)
- Fuel Trim and VE testing
- CAT efficiency testing
- Review post-scan tool data (enhanced and generic)
- Post-5 gas analysis (extra credit)
- Post scan report
- Mode 6 data

Drive It

- **A proper test drive can cut your time down and drive you halfway down the funnel before you are back in the bay.**
- **If properly performed, no data will be missed.**
- **Ask yourself, based on the customer concern, "What condition do I need to drive the vehicle under to achieve the best test results?"**

Image AI-generated

Don't Make This Mistake

Do not drive the vehicle to the scan tool

Take the scan tool to the vehicle

Starting With The Basics First

Start your diagnostic procedure by testing from the basics up, finding out what's right and what's wrong, just like the big box scope analyzers did years ago. The good thing about the old big box analyzers was that they forced us to start at the battery, starter, alternator, engine mechanical condition, emission gas readings, ignition, fuel systems, and scan data.

Basics First

- **Is the battery in good condition and the correct one for the vehicle?**
- **Is there fuel in the tank?**
- **Are the fluid levels correct?**
- **Are there signs of neglect or needed maintenance?**
- **Is anything missing that should be there?**

Gather Data

- Take the time to read up on component and system operation
  - Use of OE service information may be needed
  - www.NASTF.org
- Perform general tests first - find the funnel you need to focus on
- Move on to pinpoint tests - use the results to guide you to the next test needed
- Never assume anything!

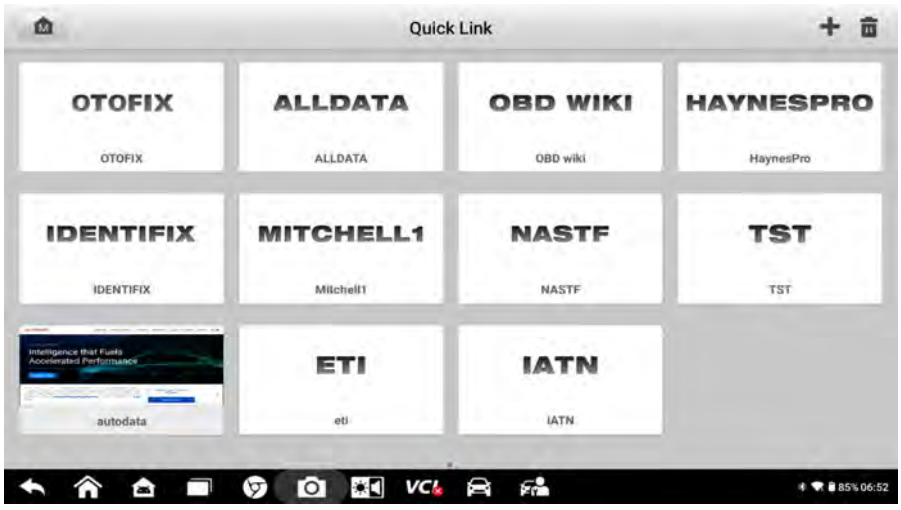
"Once you have eliminated the impossible, whatever remains, however improbable, must be the truth." - Mr. Spock

Wikipedia – Public Domain image

No Fancy Tools - Foundations

No Fancy Tools Or Equipment

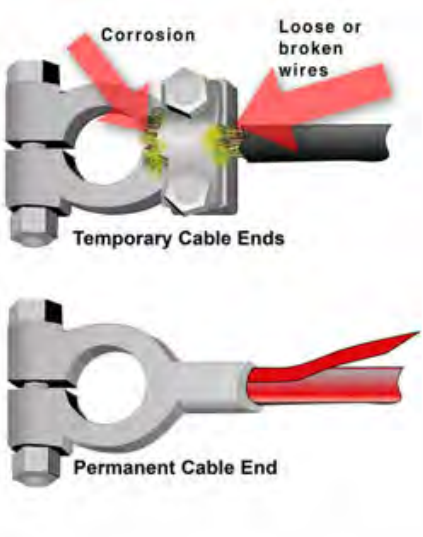
Service Info In The Scan Tool



Good Visual Inspection

Could This Cause A Code?

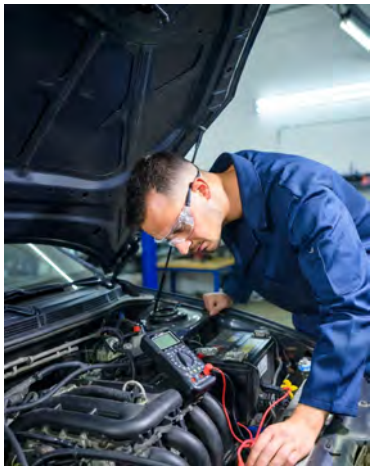
Voltage Drop



Initial Voltage Drop Checks

- **Battery negative at battery post to block**
- **Battery negative at battery post to chassis**
- **Engine block to chassis**
- **Battery positive at battery post to main fuse box**
- **Alternator B+ to battery positive at battery post**

Any reading over 500 mV should be corrected before proceeding



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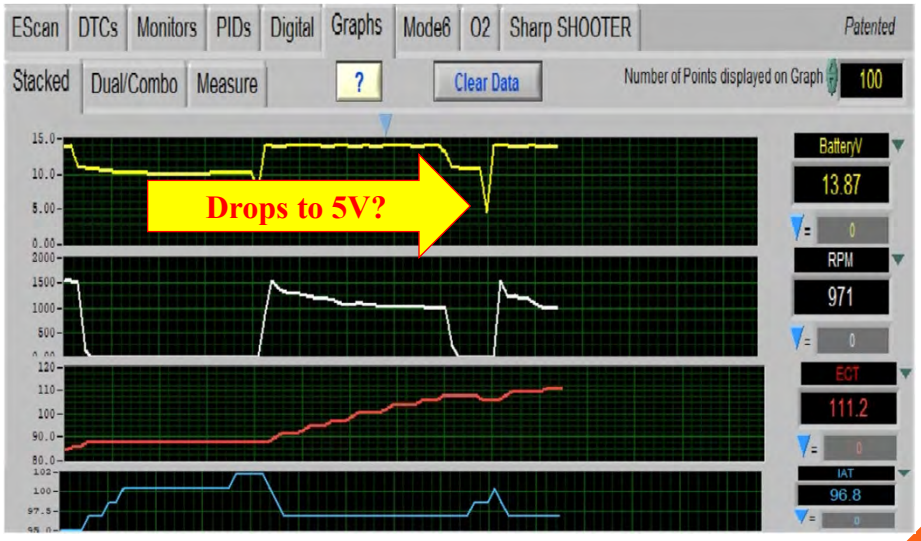
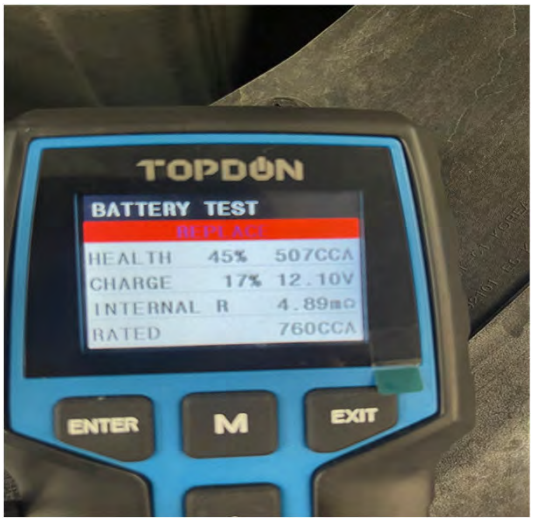
Scan Tool Battery Test (Can Also Be Done With DVOM Or DSO)



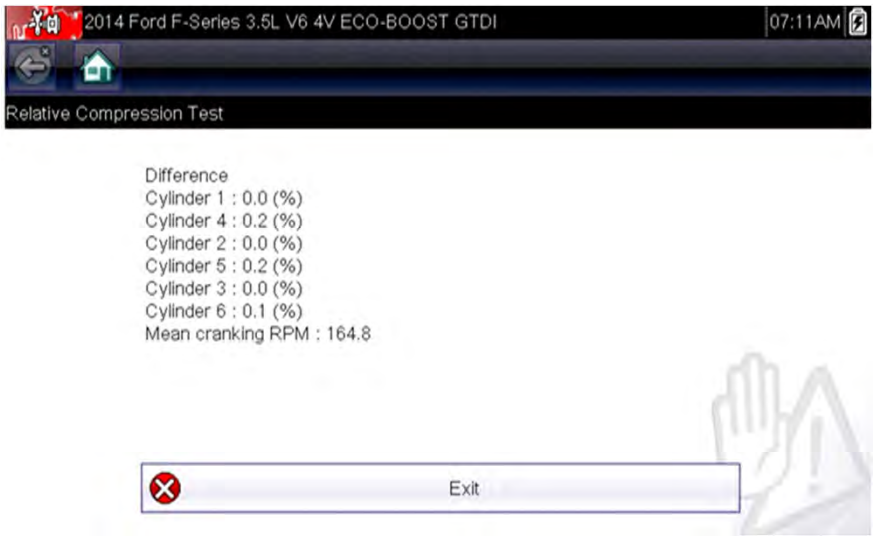
Conventional Battery Test



Relative Compression

- **If the battery passes inspection, we should move to testing the engine's mechanical condition using the relative compression method.**
- **Fully depressing the throttle pedal while cranking should disable the engine from starting on about 80% of vehicles.**
- **Toyota and Ford OE scan tools, and the ATS EScan, can perform this test at the DLC. Otherwise, use a DSO on voltage (AC coupled) or cranking amperage (high amp probe)**
- **If you don't have either, there is always the mechanic's ear test!**
  - **Good: 1111111111111111111**
  - **Bad: 11101110111011101**

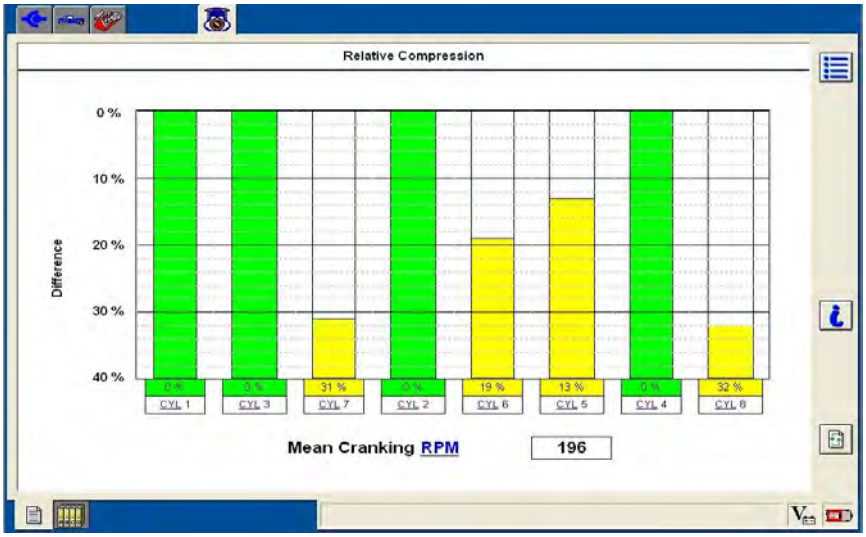
Relative Compression Examples



Relative Compression Examples

Basics First - EScan Relative Compression

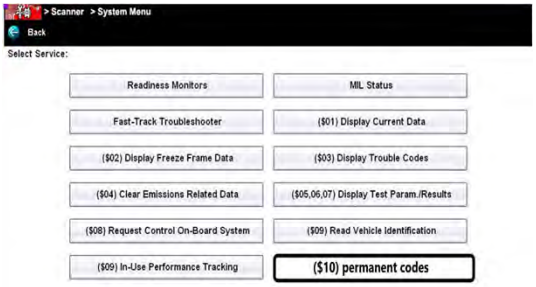
Basics First - Ford IDS Relative Compression Test



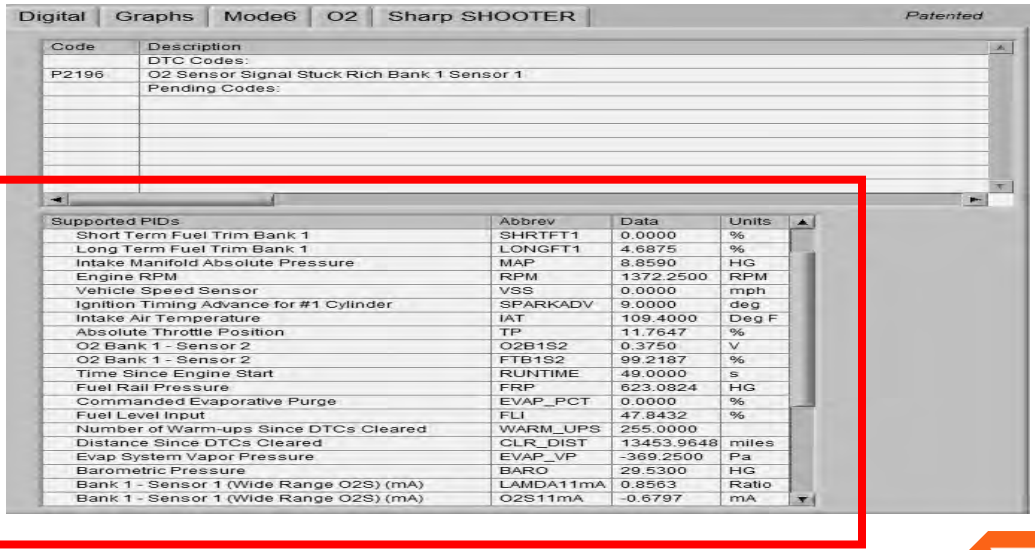
Modes, Monitors & More

10 Modes of OBD II

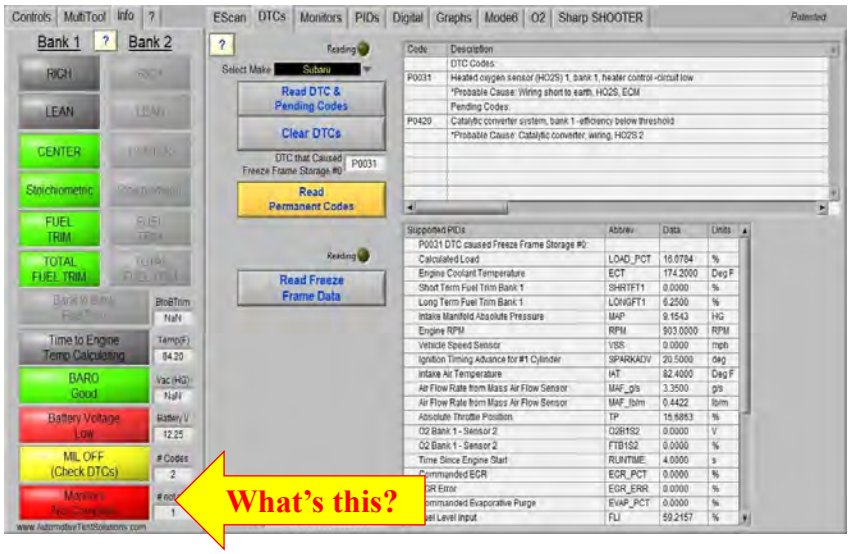
MODES	GENERIC TITLE
Mode 1	Powertrain Diagnostic Data
Mode 2	Powertrain Freeze Frame Data
Mode 3	Emission Related Powertrain DTCs
Mode 4	Clear/Reset Emission Related Diagnostic Information
Mode 5	Oxygen Sensor Monitoring Test Results
Mode 6	Test Results for Non-Continuously Monitoring Systems
Mode 7	Test Results for Continuously Monitored Systems
Mode 8	Request Control of On-Board System Test or Component
Mode 9	Request Vehicle Information
Mode 0A/10	Permanent Diagnostic Trouble Codes (DTCs) (Cleared DTCs)



Mode $01 - Live Data



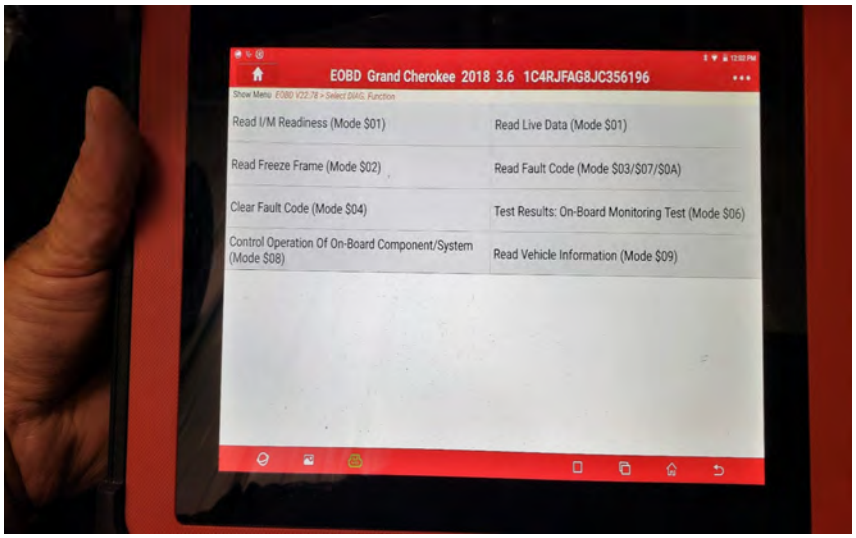
Modes $01 - Monitor Status



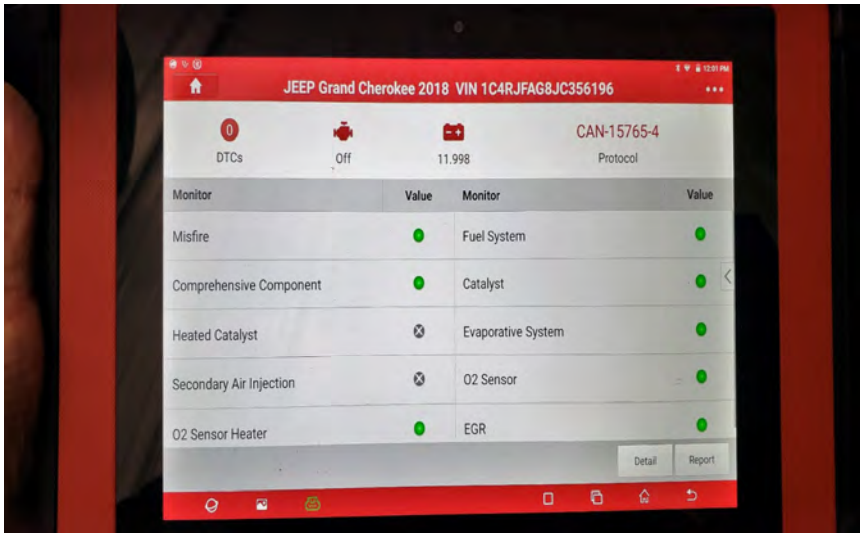
Monitors

- Onboard test strategies are programmed into the PCM to check the vehicle systems and components
- These individual test sequences are grouped into monitors
- Monitors run when conditions are right for them to run
- Vehicle operating conditions required to run Monitors are referred to as "trips"
- Using Mode $04 or disconnecting the battery will reset the Monitors
- A completed Monitor does not mean that no problems were found, only that the conditions needed to perform all the tests in that Monitor have been met

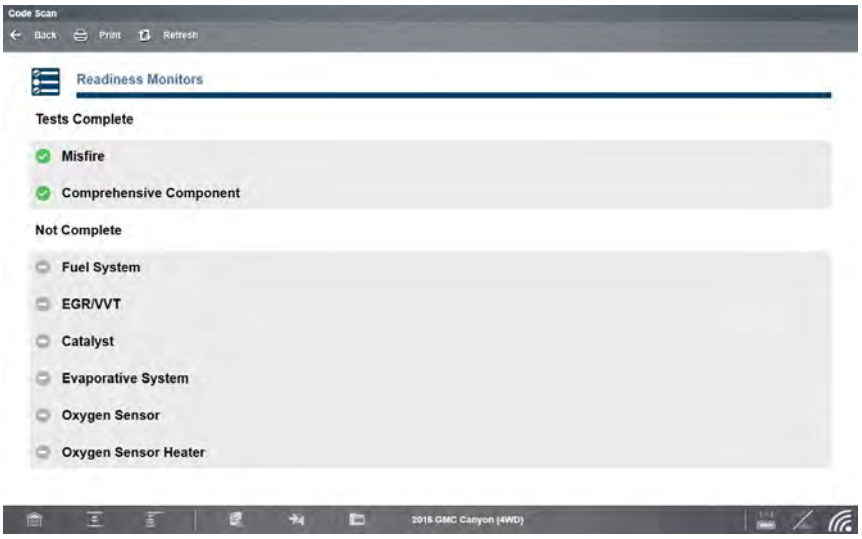
Readiness Status - Monitors



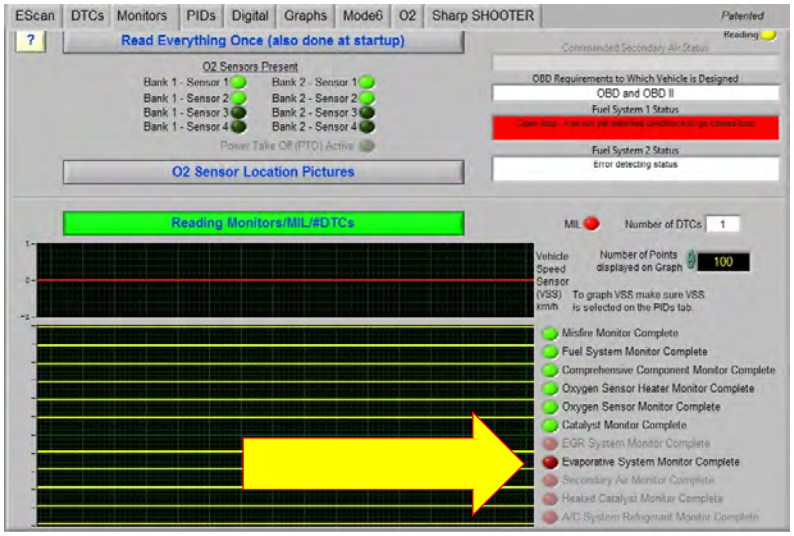
Monitors



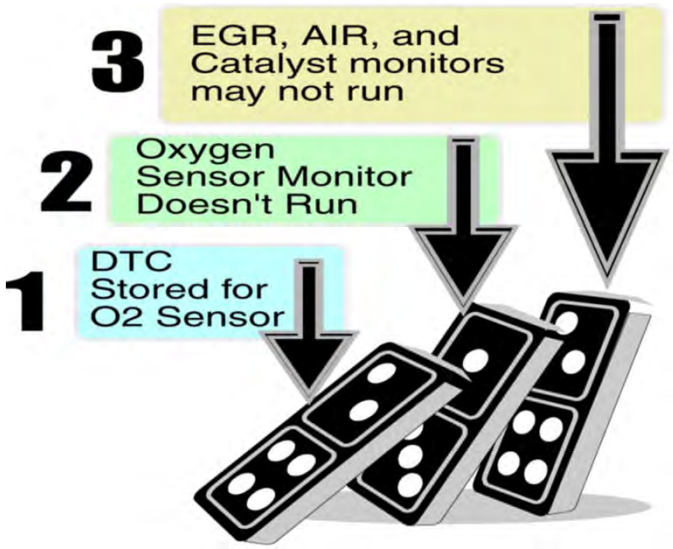
Monitors



Monitors



DTCs & The Domino Effect



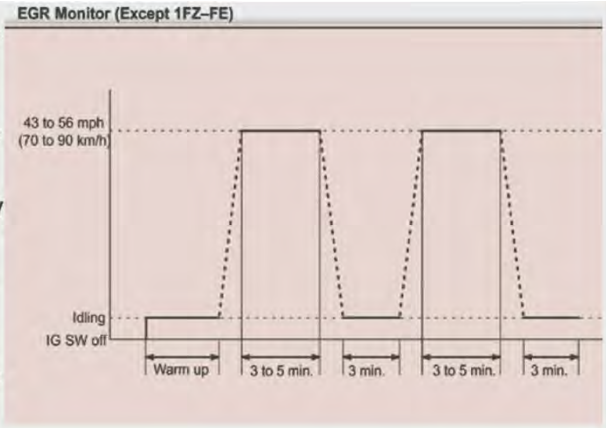
Generic Drive Cycle

- **Some vehicles must sit for 8 hours before the test without being started. This is primarily for the EVAP monitor.**
- **Warm the engine to normal operating temperature before driving it.**
- **Drive the vehicle for 10 minutes at highway speeds.**
- **Drive the vehicle for 20 minutes in stop-and-go traffic, with at least 4 idle periods of 2-3 minutes each. Do not turn the ignition off at anytime during the cycle.**
- **When completed, turn the key off and wait 3 minutes before rechecking the status.**

OEM Drive Cycle Example1

This Toyota drive cycle is specifically for the EGR monitor, and it is engine specific. Each monitor has its own defined drive cycle.

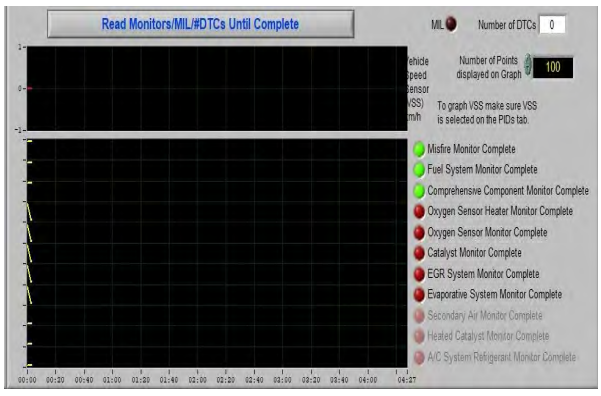
Note that one of the entry conditions listed for this monitor is that the MIL must be off. To eliminate other conditions that might result in false test results, the monitor will not run at extremely high altitude or at very low ambient temperatures. The monitor is also suspended on a cold engine.



Source Toyota Motor Company

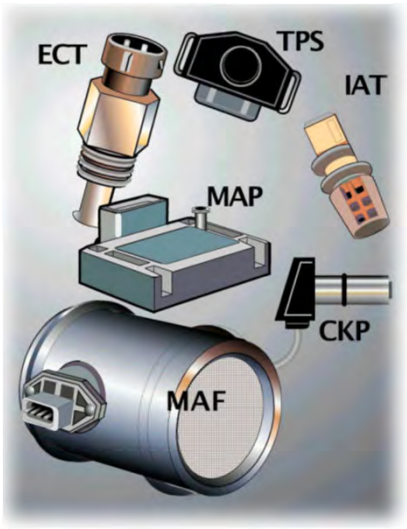
Continuous Monitors

- **Monitors that run continuously as the vehicle is operated**
- **Three Continuous Monitors: Comprehensive Component, Fuel System, and Misfire Monitors**
- **Continuous Monitors should always appear as "Ready" when viewed on a scan tool. (Some scan tools and inspection machines may show them as "Complete," "Done," or "Yes.")**



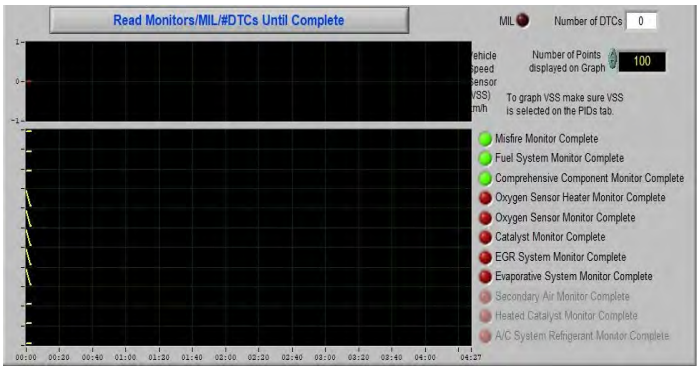
Comprehensive Component Monitor

- **Tests for electrical circuit condition**
- **Tests for sensor logic (rationality)**
- **Tests for actuator operation (functionality)**

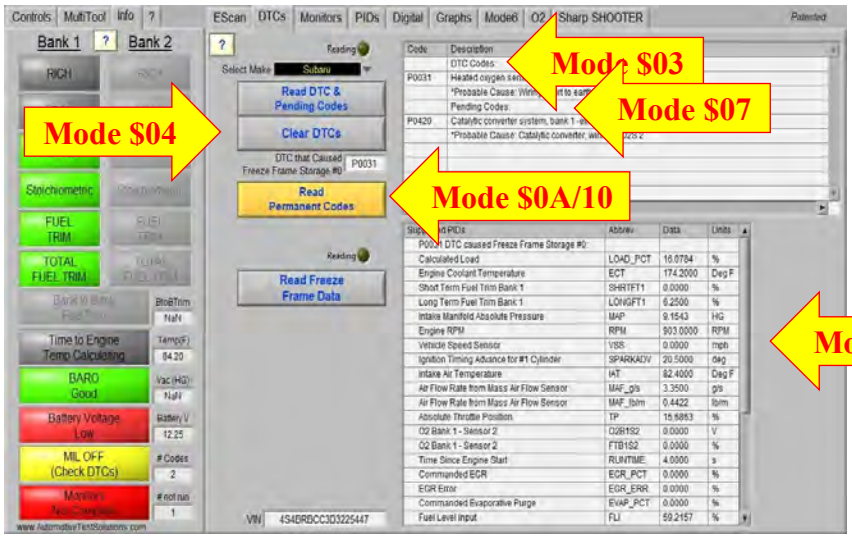


Non-Continuous Monitors

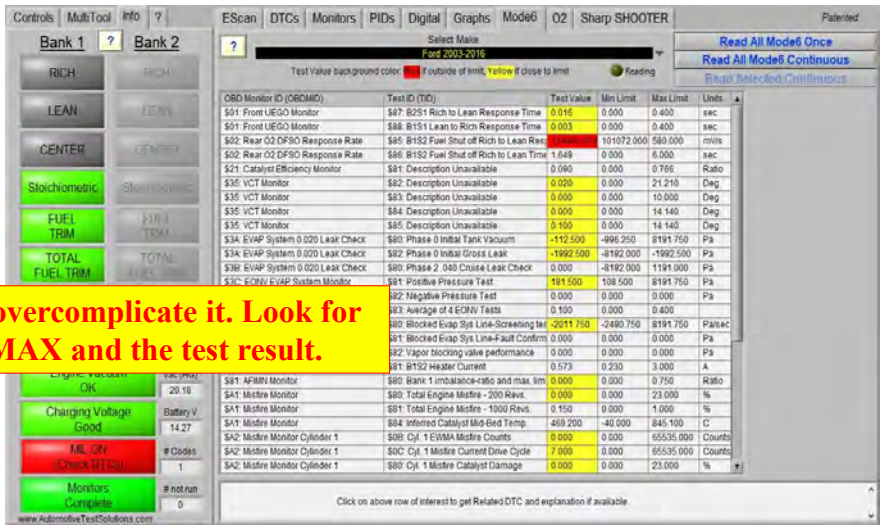
Non-Continuous Monitors run once per Trip. Unlike Continuous Monitors, the status of Non - Continuous Monitors is checked as part of the OBD II emissions test. If there are too many incomplete (Not Ready) Monitors, the vehicle fails an emissions test and may illuminate the MIL.



Modes $02, $03, $04, $07, $0A/10



Mode $06



Don't overcomplicate it. Look for MIN, MAX and the test result.

Example Of Mode 6 Data

EOBD V4.90

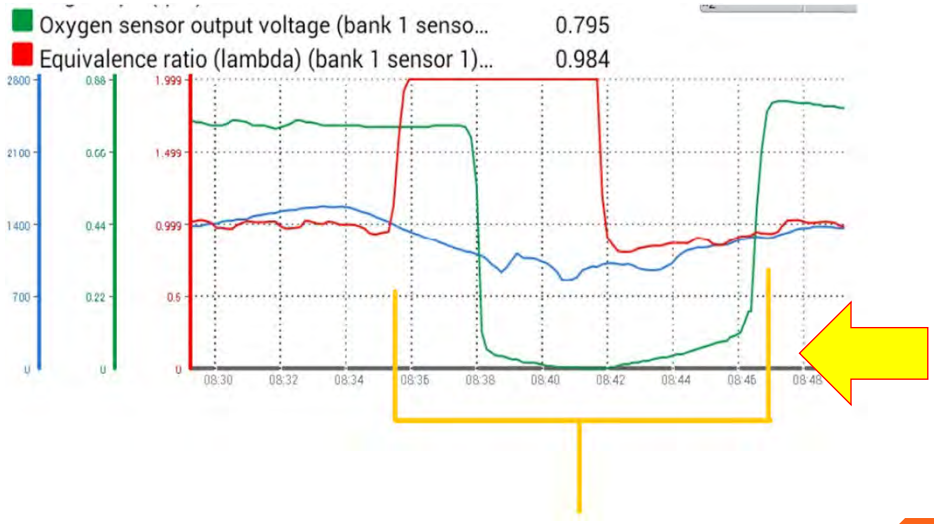
On-Board monitor(FORD)

Description	MID	TID	Min	Max	Value	Unit	Result
Heated Oxygen Sensor (HO2S) (bank 1 sensor 2) fuel shut-off rich to lean response time delay	02	86	00:00	00:10	00:02	m:s	OK
Heated Oxygen Sensor (HO2S) monitor (bank 2 sensor 1)	05						
Oxygen sensor (bank 2 sensor 1) rich to lean response time	05	87	00:00	00:00	00:00	m:s	OK

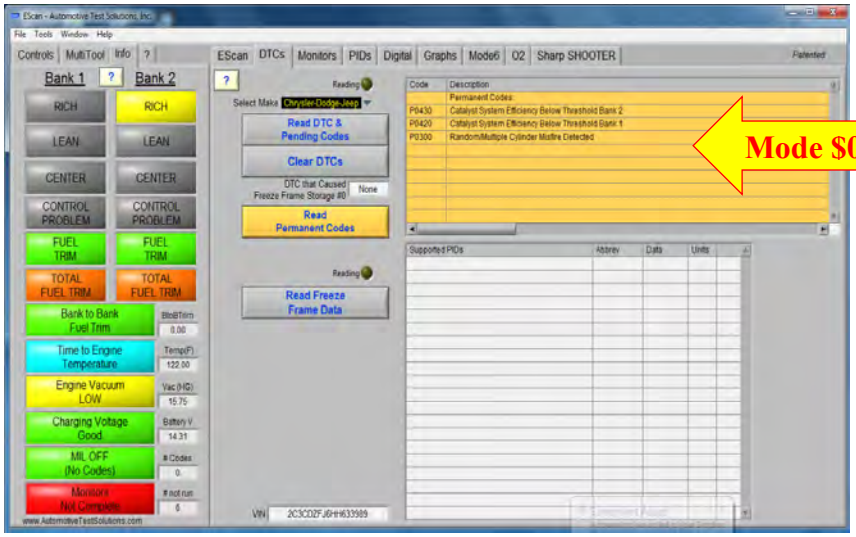
VIN:1FTEW1EP0JFE72567
Car EOBD/ISO 15765-4(CAN)

ESC

Example Of Mode 6 Data



Mode $0A (Mode 10)



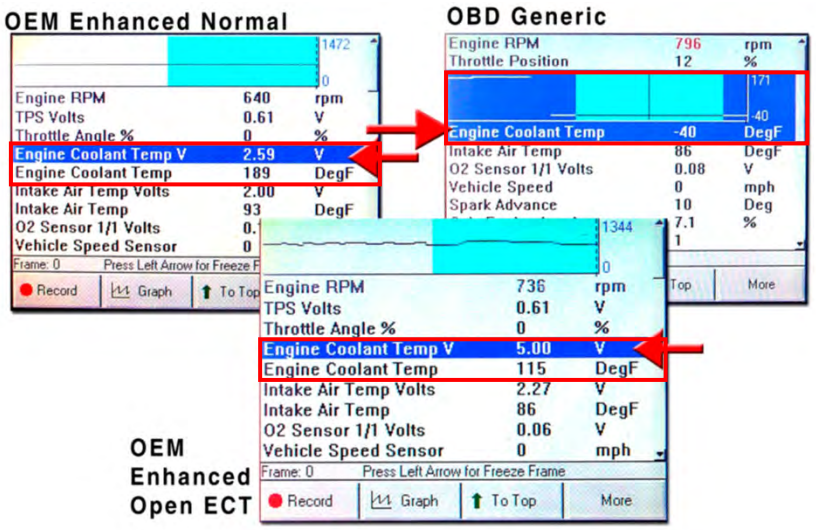
Things To Know About OBD II

Dealership (Factory)
- Increased data PIDS
- Programming
- Diagnosis of all vehicle systems

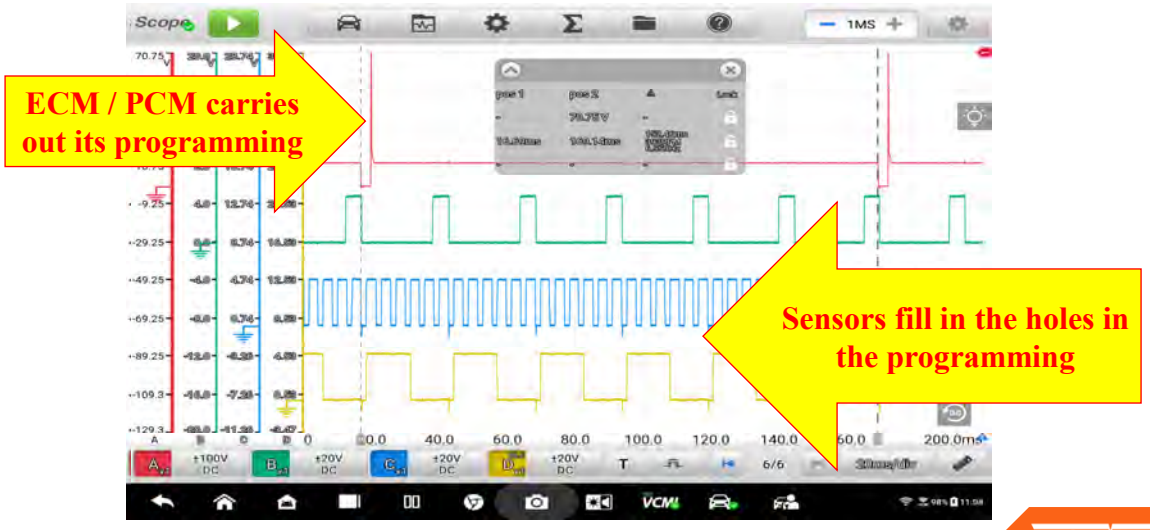
Aftermarket Enhanced
- Full datastream
- Most other computer system datastreams
- Actuator output test
- Diagnosis of complete vehicle systems

Generic OBD II
- Read Generic/Global DTCs
- Read Freeze Frame
- Erase DTCs
- Monitor status
- 10 modes

Actual vs. Calculated Data Values



How The ECM/PCM Does It's Job



Diagnostic Strategies - With Or Without DTCs

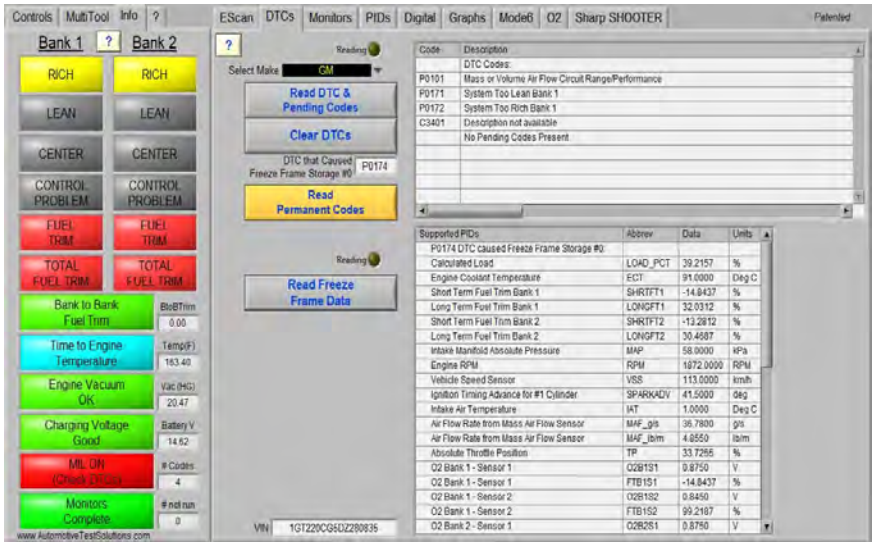
2013 GMC Sierra 2500 6.0L Flex Fuel

- **Verify concern - MIL on**
- **Check for DTCs - P0101 Mass Air Performance, P0171, P0174 Bank 1 and 2 Lean Condition, P0172, P0715 Bank 1 & 2 Rich Condition**
- **Check for TSBs - No related bulletins found**

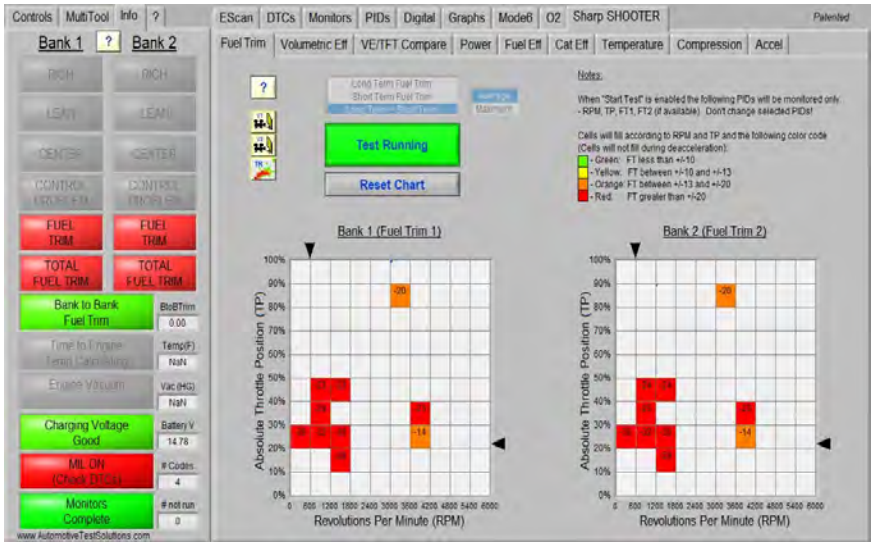
Code	Description
	DTC Codes:
P0101	Mass or Volume Air Flow Circuit Range/Performance
P0171	System Too Lean Bank 1
P0172	System Too Rich Bank 1
C3401	Description not available
	No Pending Codes Present

So where do we go with our diagnosis?

2013 GMC Sierra 2500 6.0L Flex Fuel

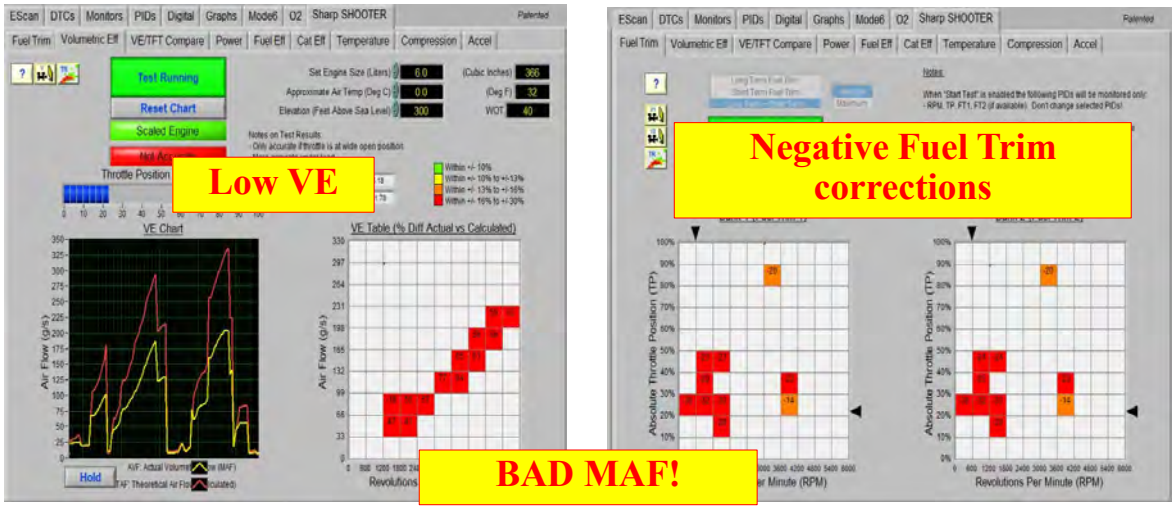


2013 GMC Sierra 2500 6.0L Flex Fuel

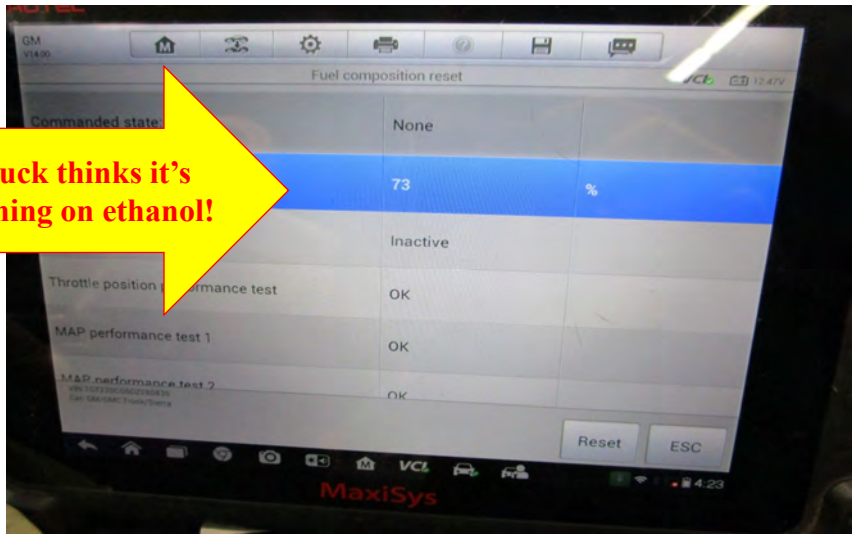


2013 GMC Sierra 2500 6.0L Flex Fuel

Consider The Data



2013 GMC Sierra 2500 6.0L Flex Fuel

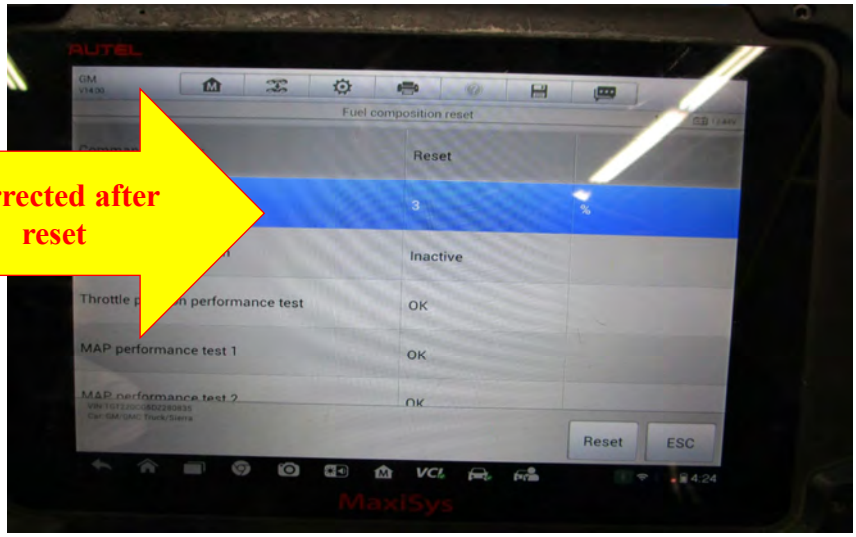


Truck thinks it's running on ethanol!

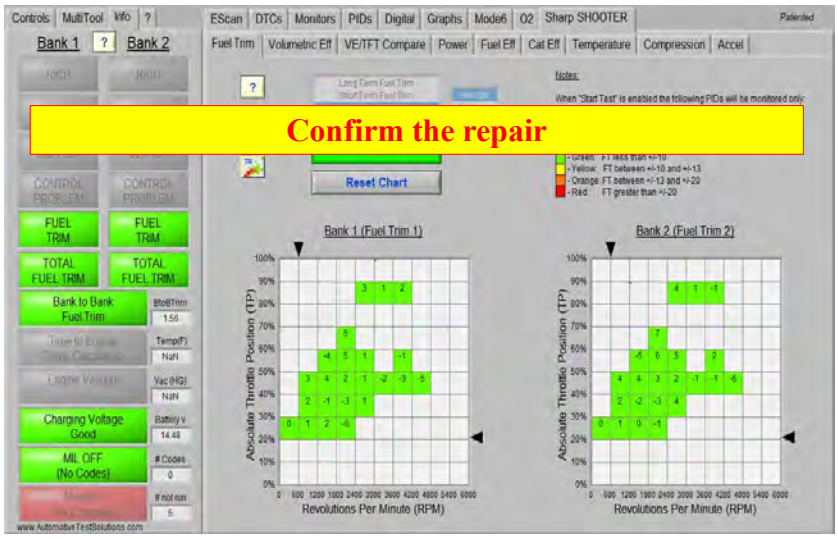
2013 GMC Sierra 2500 6.0L Flex Fuel

But it's not…

2013 GMC Sierra 2500 6.0L Flex Fuel



2013 GMC Sierra 2500 6.0L Flex Fuel

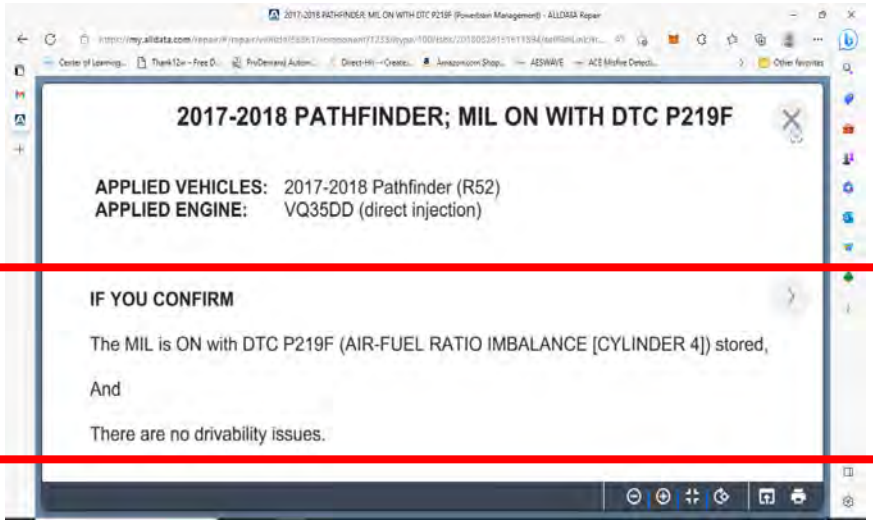


2017 Pathfinder

- **Verify the concern - MIL is on**
- **Check for DTCs - Code P219F Air Fuel Ratio Imbalance (Cylinder 4) found**

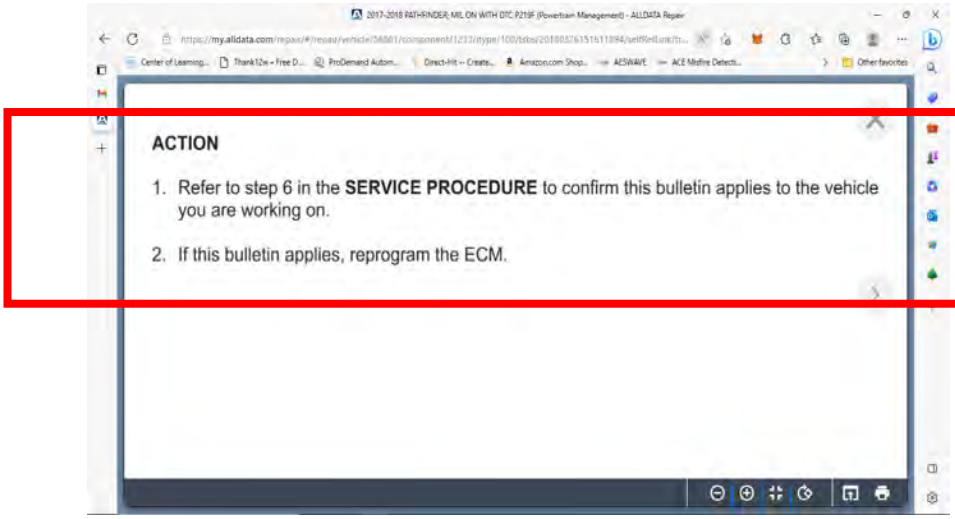
What would be your next move to continue your basic 3-step diagnostic process?

Check For TSBs



Courtesy of AllData

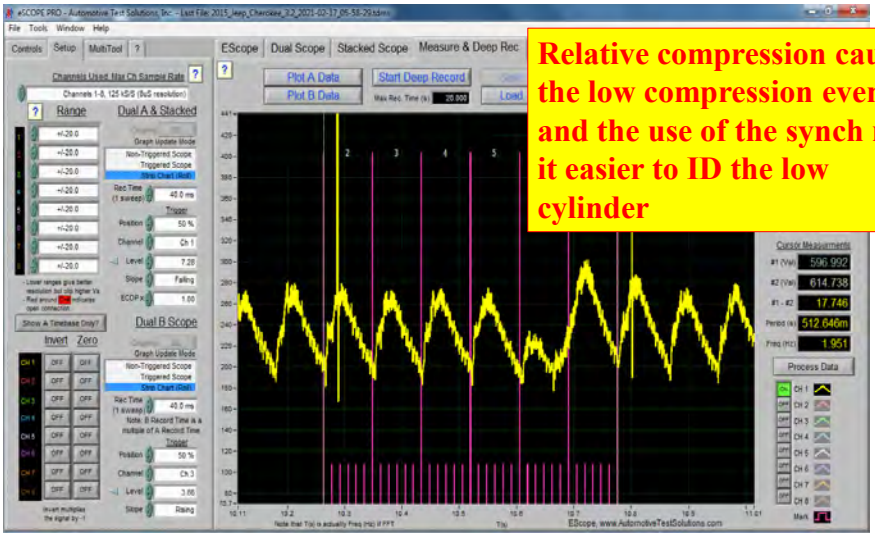
2017 Pathfinder



Courtesy of AllData

2015 Jeep Grand Cherokee 3.6L / 24 V

2015 Jeep Grand Cherokee 3.6L / 24 V



Relative compression caught the low compression event, and the use of the synch made it easier to ID the low cylinder

2015 Jeep Grand Cherokee 3.6L / 24 V

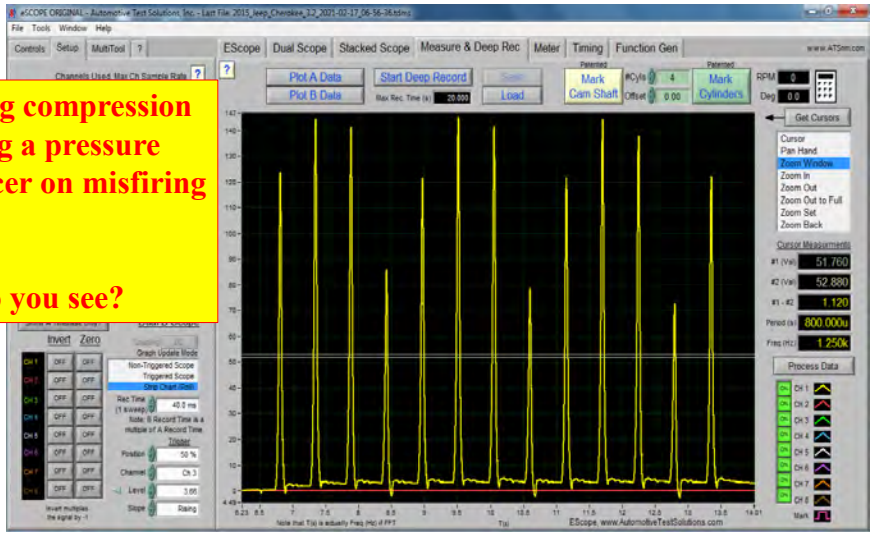
- **Compression test, both dry and wet, did not show a problem though**
- **Leak down test also failed to show a fault**

How can that be?

2015 Jeep Grand Cherokee 3.6L / 24 V

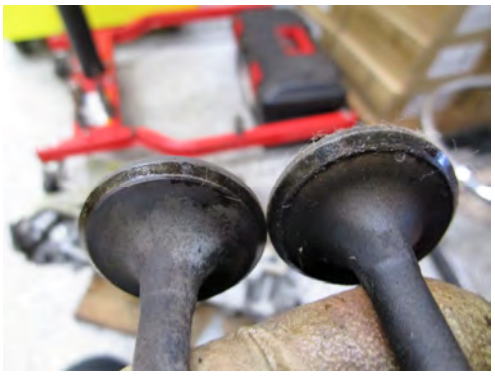
Cranking compression test using a pressure transducer on misfiring cylinder

What do you see?



2015 Jeep Grand Cherokee 3.6L / 24 V

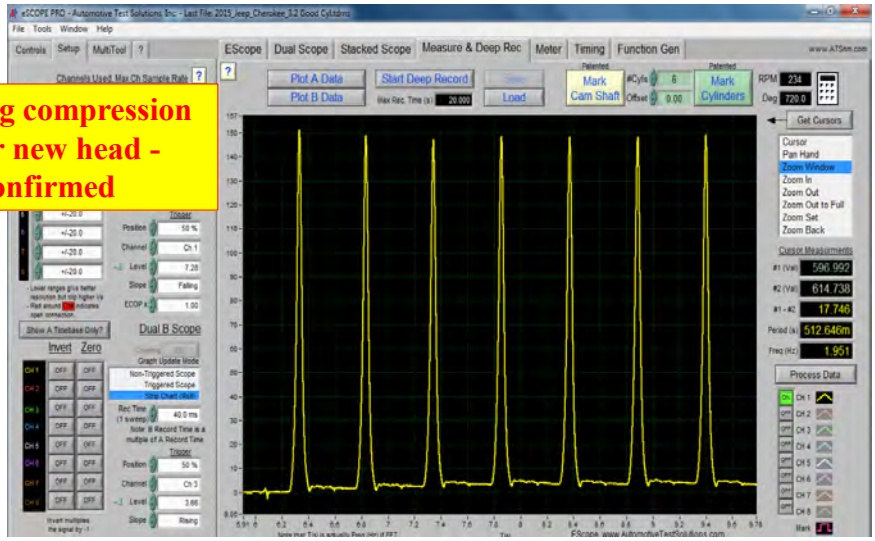
2015 Jeep Grand Cherokee 3.6L / 24 V



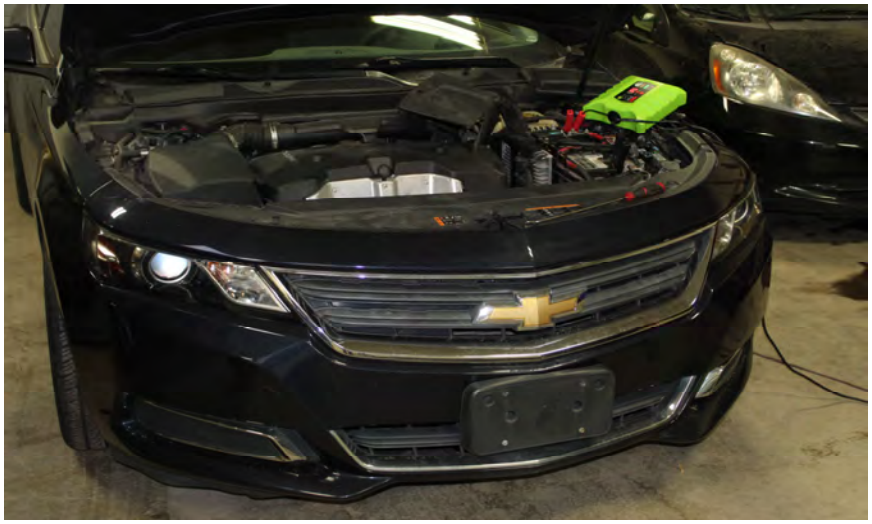
2015 Jeep Grand Cherokee 3.6L / 24 V

2015 Jeep Grand Cherokee 3.6L / 24 V

Cranking compression test after new head - repair confirmed



2015 Chevrolet Impala



Building A Diagnostic Worksheet

- Basic 3 step diagnostic process
- Battery, starting and charging (building a supplemental worksheet)
- Pre-scan report
- Review pre-scan tool data (enhanced and generic)
- Time to temperature
- Pre 5 gas analysis (extra credit)
- Engine mechanical

Building A Diagnostic Worksheet

- Ignition System
- Fuel Delivery System (Extra Credit)
- Fuel Trim and VE Testing
- CAT Efficiency Testing
- Review Post-Scan Tool Data (Enhanced and Generic)
- Post - 5 Gas Analysis (Extra Credit)
- Post Scan Report
- Review Mode 6 Data

P305F Dual Battery Control Module Performance Code

- The Check Engine light is on.
- The technician does a code clear and takes the vehicle for a test drive. It is then noted that during a Start/Stop event, the check engine light illuminates again.
- A code P305F is stored in the controllers (PCM) memory.

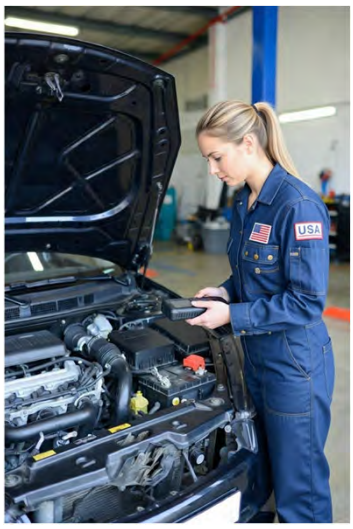


Image AI-generated

P305F Dual Battery Control Module Performance Worksheet

- Obtain trouble code information
- Review description and operation
- Review any and all TSBs that may apply
- Check resources for pattern failure/known repairs
- Review wiring diagrams and the trouble code chart

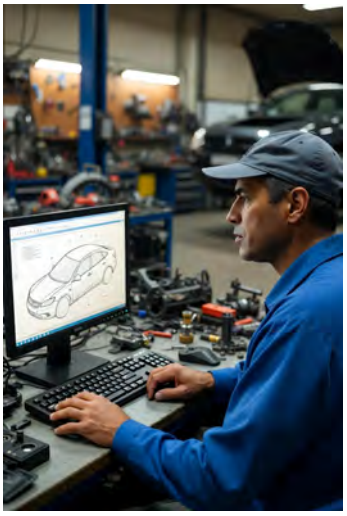
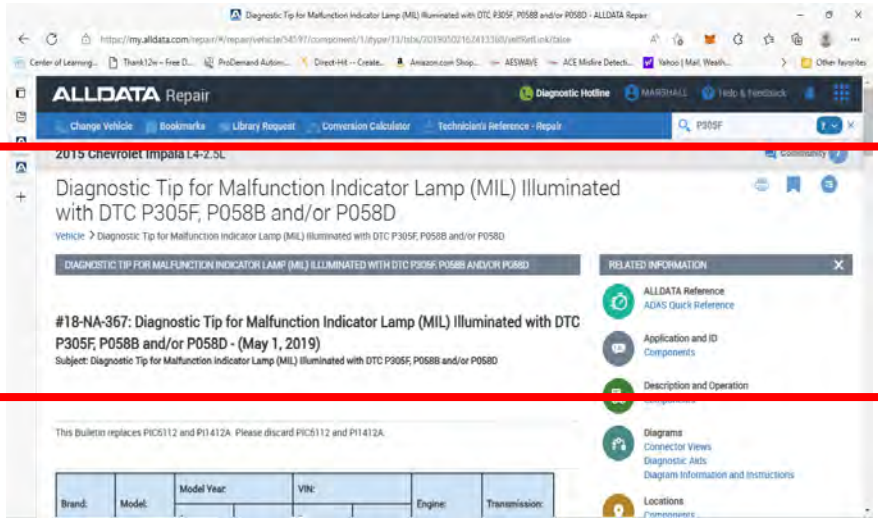


Image AI-generated

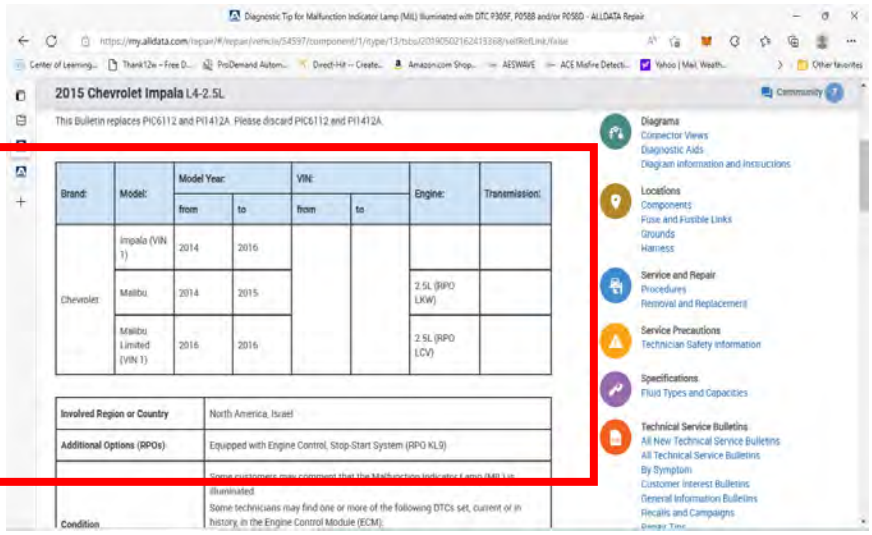
Check For DTCs - P305F Dual Battery Control Module Performance

Check For TSBs



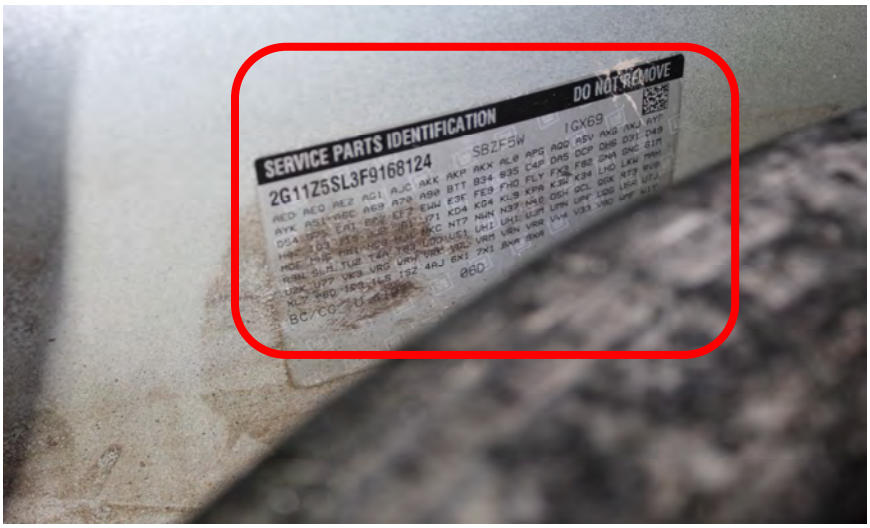
Courtesy of AllData

Need RPO Information

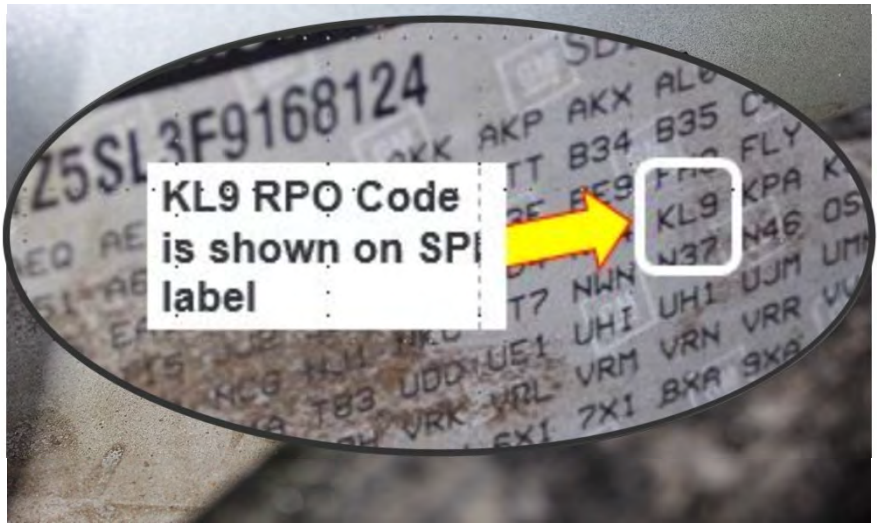


Courtesy of AllData

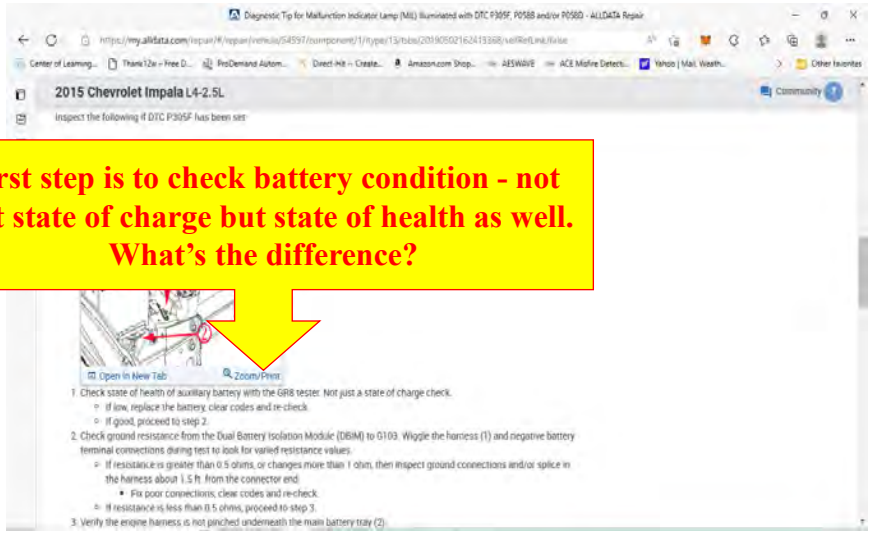
Determine RPO Codes That Apply



Determine RPO Codes That Apply

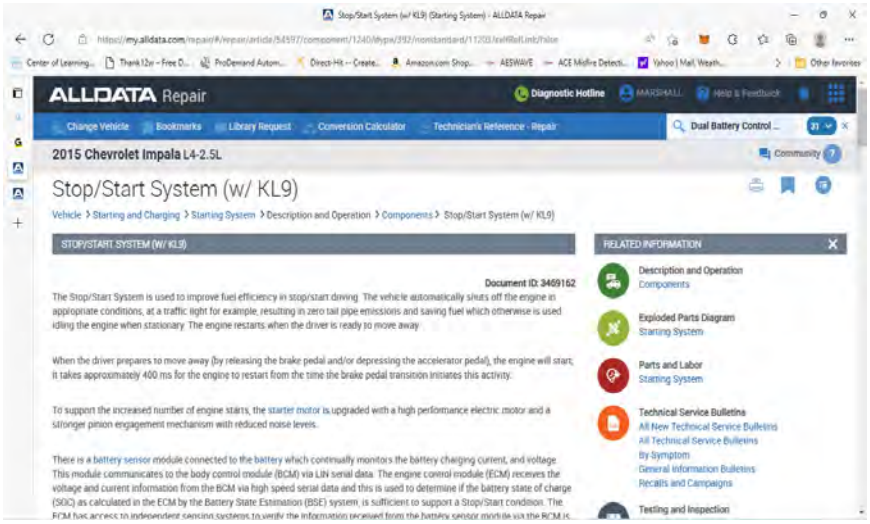


GM Bulletin



Courtesy of AllData

Gathering Data - Description & Operation



Courtesy of AllData

Description & Operation - Dual Battery Control Module (DBCM)

- **The DBCM is used to isolate 12V primary battery from vehicle loads during cranking events**
- **It switches primary and auxiliary batteries in and out at appropriate times to support vehicle loads and battery charging**
- **It does not utilize vehicle BUS communication**

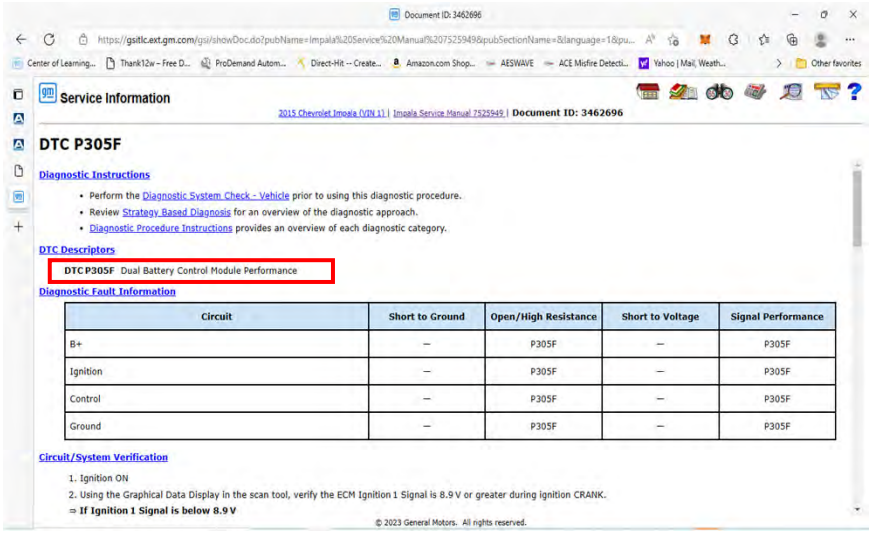
How The Primary & Auxiliary Batteries Are Used

Vehicle Load Supported by

Event	Primary Battery	Auxiliary Battery
Key off	Yes	No
Key on	Yes	Yes
*Key Crank	No	Yes
Run	Yes	Yes
Auto-stop	Yes	No
*Auto-start	No	Yes
*During a Key Crank or Auto-start event, the primary battery supplies power to the Starter Motor		

Battery voltages should be monitored under actual driving conditions by using graphical analysis.

Gathering Data - Trouble Code Chart Information



Service Information

2015 Chevrolet Impala (VIN 1) | Impala Service Manual 7525949 | Document ID: 3462696

DTC P305F

Diagnostic Instructions

- Perform the Diagnostic System Check - Vehicle prior to using this diagnostic procedure.
- Review Strategy Based Diagnosis for an overview of the diagnostic approach.
- Diagnostic Procedure Instructions provides an overview of each diagnostic category.

DTC Descriptors

DTC P305F Dual Battery Control Module Performance

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
B+	–	P305F	–	P305F
Ignition	–	P305F	–	P305F
Control	–	P305F	–	P305F
Ground	–	P305F	–	P305F

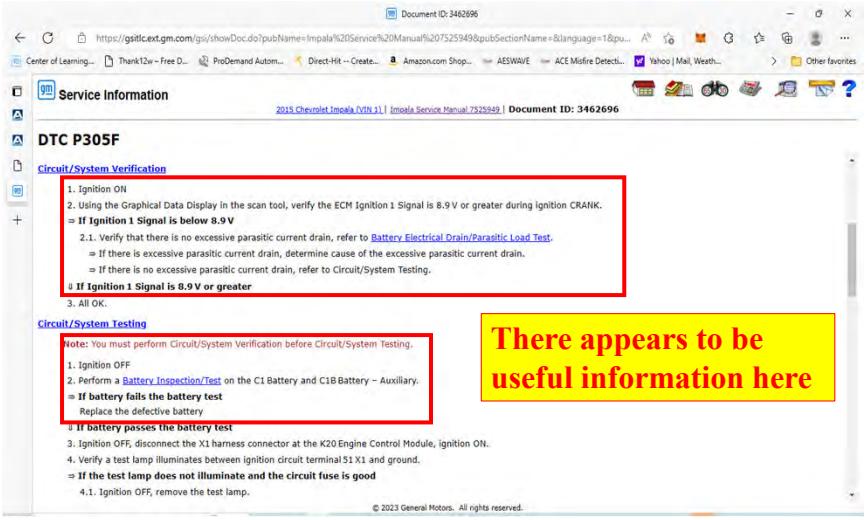
Circuit/System Verification

1. Ignition ON
2. Using the Graphical Data Display in the scan tool, verify the ECM Ignition 1 Signal is 8.9 V or greater during ignition CRANK.

⇒ **If Ignition 1 Signal is below 8.9 V**

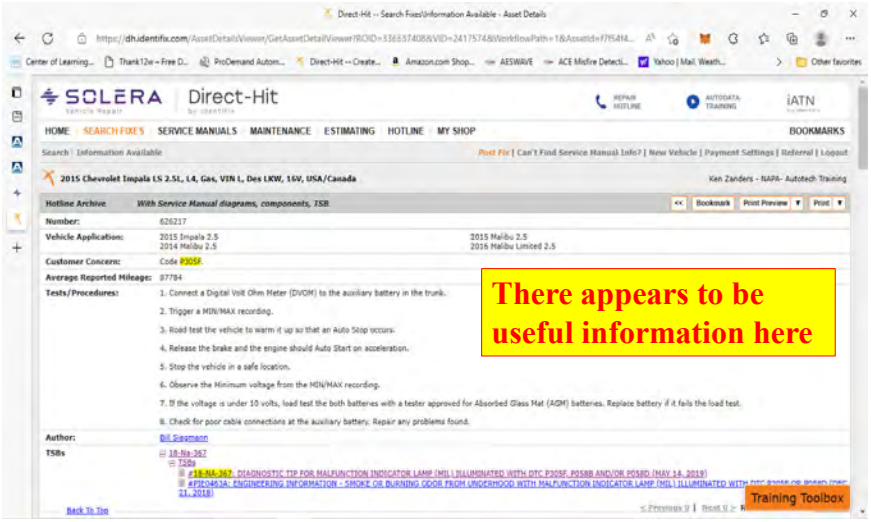
Courtesy of GM

Gathering Data - Trouble Code Chart Information



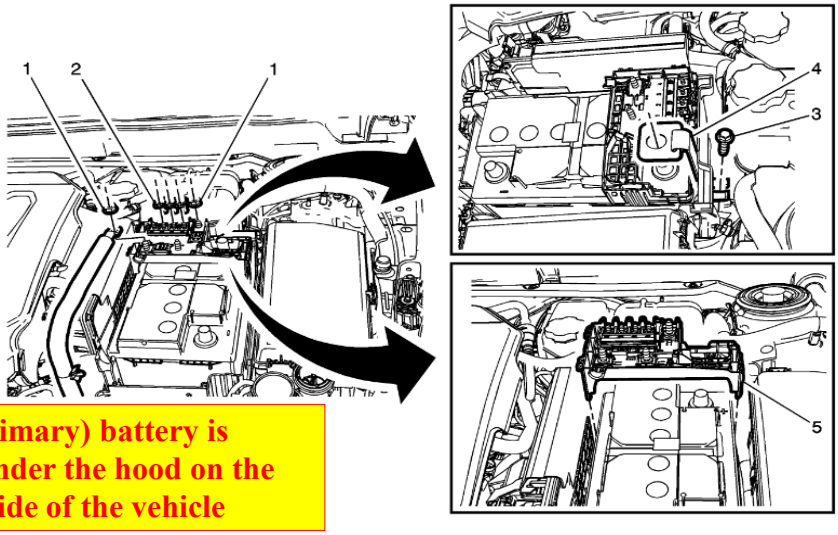
Courtesy of GM

Gathering Data - IdentiFix Known Repairs



Courtesy of IdentiFix

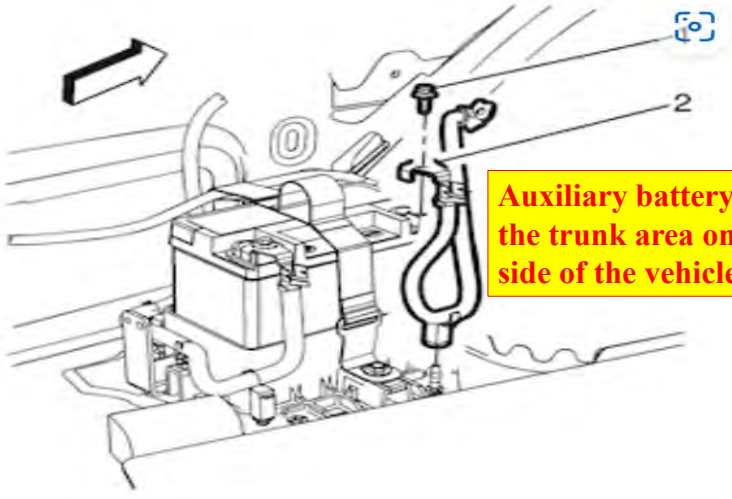
Gathering Data - Location Of Primary Battery



AGM (Primary) battery is located under the hood on the driver's side of the vehicle

Courtesy of AllData

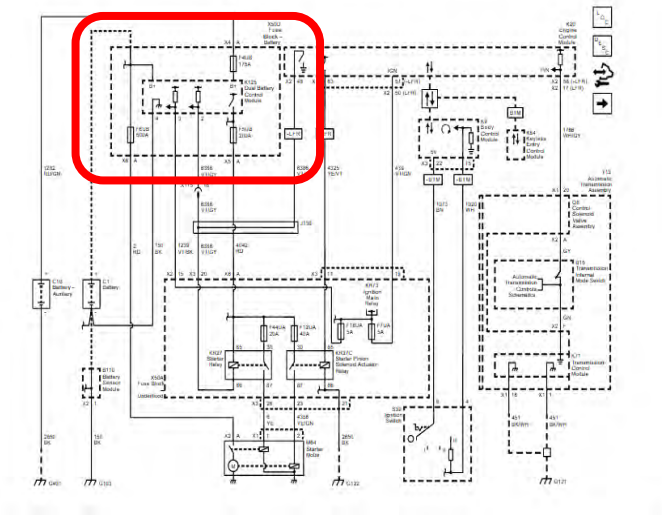
Gathering Data - Location Of Auxiliary Battery



Auxiliary battery is located in the trunk area on the driver's side of the vehicle.

Courtesy of AllData

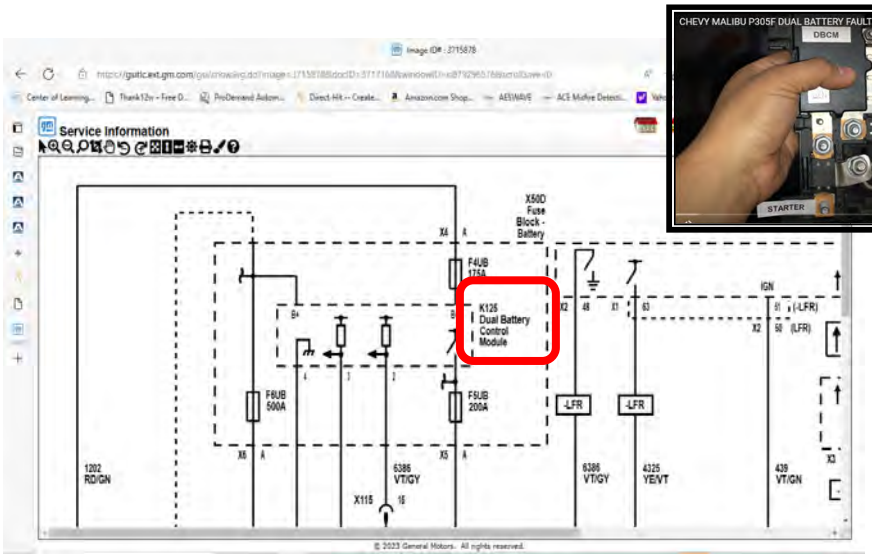
Gathering Data - Wiring Diagram



2015 Chevrolet Impala L4-2.5L

Courtesy of AllData

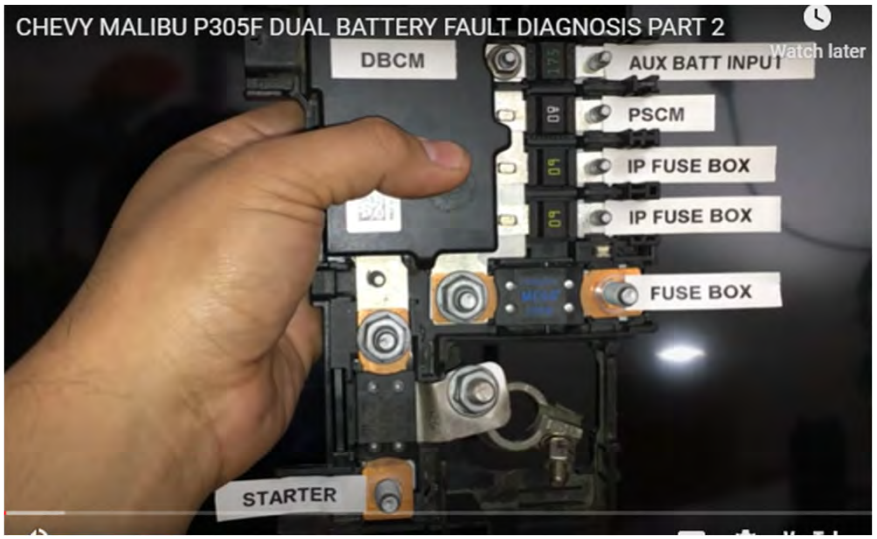
Gathering Data - Wiring Diagram



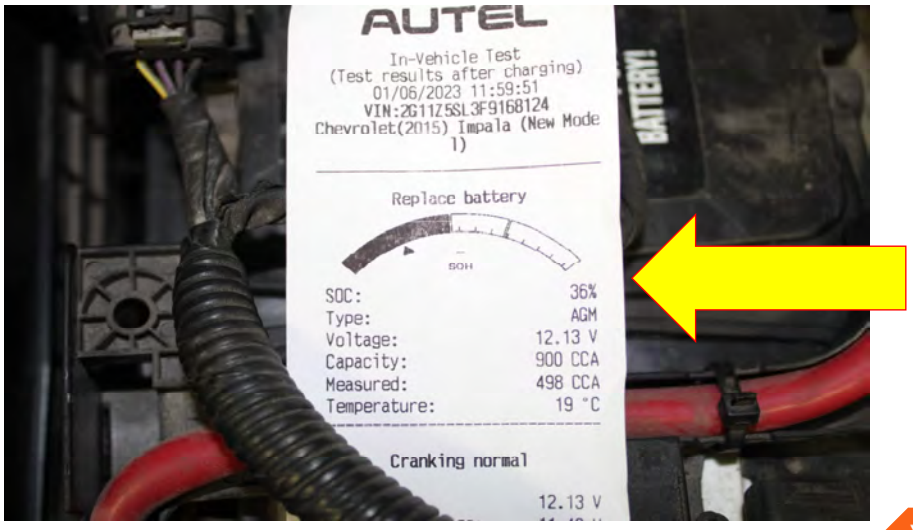
Courtesy of GM

Gathering Data - Location Of DCBM

Gathering Data - DCBM Terminal Identification



Test Analysis



Test Results & Repair

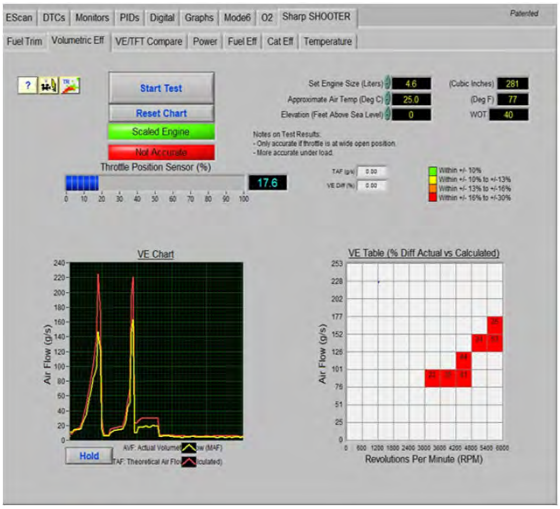
- **OCV voltage 12.13 volts (SOC)**
- **Cranking voltage 11.4 volts**
- **Measured CCA of 498 with a capacity of 900 CCA (SOH)**
- **The AGM (primary) battery has failed the battery test and was replaced**
- **The Auxiliary battery was also replaced based on the graphical analysis results**

With batteries replaced, the code was cleared, and the vehicle was test-driven. Repair confirmed.

Just For Fun - 2002 Mustang GT Eye Burner

- 2002 Mustang GT
- 4.6L SOHC
- Engine performance work done
- Customer complaint: "Can't stand by the car, the fuel burns your eyes!"
- Has a custom tune in PCM, tuner says tune is ok, not the problem
- No codes, runs great

2002 Mustang GT



Size Matters

Key Takeaways

- Always verify - test drive and record data
- Global OBD II first
- Take the time to read code, component and system operation and conditions needed
- Check for TSBs
- Research similar faults and their fixes - but don't rely on them as the answer!
- Develop your strategy - Test before you replace
- Follow the data - don't make the data fit your assumptions
- Confirm every repair

Questions?

Thank You !

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