

# 2025 4G Ford Industrial Engine Training

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## Overview

- About EDI
  - Industrializing a Ford Engine
  - Introduce the Ford Engine Lineup.
  - Engine Basics
- Diagnostics and Trouble Shooting.
  - EDItechinfo.com
  - Public Info, Service Diagnostics.
  - Software Diagnostics.
- Fuel system; LPG, NG
  - Differences in Setups
  - Gasoline Fuel Pump, Fuel Block, Injector Wiring
  - Gaseous Fuel DEPR and Lock Off Valve Wiring
  - Exhaust System.
- Engine Electronics
  - 4G Specs/Capabilities
  - Controls Interface
  - Sensors
  - Fuse box
  - Component Wiring; MAP, Throttle, CAM, CRANK, ECT/CHT
  - Starting and Charging Circuits
- Engine Display Interface Software (EDIS)
  - Purpose
  - Installing the Software
  - Using the Software
  - Using the MIL& DTC.





# Who is Engine Distributors?

Engine Distributors, Inc. is a leading distributor of Ford Power Products and Crusader engines and parts for over 30 years. As a family-owned business since 1958, EDI is recognized as a leader in the industry. President Jaime Cummins and Vice President Glenn Cummins III have taken all of the necessary steps to provide OEM's and consumers with product support, sales and service. Our highly experienced personnel, coupled with our deep product line of inventory, insure our commitment to total customer satisfaction. Our corporate office is located in Blackwood, NJ and with our US Dealer network and Worldwide distributor network; EDI is dedicated to distributing and supporting our product lines domestically and globally.



# Industrializing a Ford Engine

- EDI purchases current production base engines from Ford
  - Ford has excess capacity within their plants
  - Engines selected are based on availability and their design for dry fuels
- EDI fits the control and fuel system to the engine
  - Engine is EPA, CARB and Stage 5 certified
- Other items are added onto the engine
  - Bell housing and flywheel
  - Turnkey Cooling Fan and Radiator Packages



# **Engine Identification**

- Affixed to the valve cover of the engine
  - Contains the model and serial number
  - Use all numbers when seeking information or ordering replacement parts



Figure 1: Engine identification label. Model and Serial Number.



## **Emissions Labels**

 Also located on the engine valve cover or Engine ID Plate.



#### Figure 2: Emissions label

\*Useful life is the amount of time the engine and its emissions components are warrantied to comply with emissions regulations.



## Emissions Labels.

Europe Stage 5 WSG873 Label



#### Legacy 2.3L Engine Label.

DISTR	BUTORS	CKWOOD, NJ 08012	TUNE UP SPECIFICATION
	INC.	1-800-220-2700	SPARK PLUG GAP (IN/MM
ENGINE DISP:	EMISSION STANDARDS	EMISSION CONTROL SYSTEM	0.041 - 0.045
2.3 LITER	1.1 G/KW-HR HC + NOX 12.5 G/KW-HR CO	MFI, MIX, ECM, 2HO2S, TWC	CERTIFICATION LEVELS 0.645 G/KW-HR HC + NOX
ENGINE FAMILY:	MAXIMUM RATED HP	ENGINE USEFUL LIFE	10.87 G/KW-HR CO
7EDIB02.3DSG	75 HP	5000 HRS / 7 YRS	(NO OTHER ADJUSTMENT NECESS
THIS ENGINE IS E FUEL OR GASOL	QUIPPED WITH AN ALTERN INE, AND COMPLIES WITH NEW 2007 OFF-ROAD LAR	ATIVE FUEL SYSTEM, THIS ENGIN APPLICABLE CALIFORNIA AND U. GE SPARK-IGNITION ENGINES 25	E IS CERTIFIED TO OPERATE O S. EPA REGULATIONS RELATEI HP AND GREATER.

#### Engine Specifications MSG425. Ford 2.5L – 4 cylinder.

- Engine Type...... I-4, DOHC, Intake Cam Phaser
- Bore and Stroke...... 3.5"x3.93"
- Displacement...... 2.5L (152.5 CID)
- Compression Ratio...... 9.7:1

- Basic Dimensions...... L30.3" x W23.3"x H32.6"
- Certified on Gasoline, LPG, and NG fuels.
- EPA, CARB, & Stage 5 Certified.
  - 650 3200rpm
- SAE 4 Housing and SAE 10" flywheel available



#### Engine Specifications LSG635. Ford 3.5L – 6 cylinder.

- ▶ Engine Type...... V–6, DOHC, 4 Cam Phasers.
- Bore and Stroke...... 3.6"x3.4"
- Displacement....... 3.5L (212 CID)
- Compression Ratio..... 11.8:1

- Basic Dimensions...... L32.4" x W27.5"x H33.7"
- Certified on Gasoline, LPG, and NG fuels.
- EPA, CARB & Stage 5 certified.
  - 800 3200rpm
- SAE 3 Housing and SAE 11.5" flywheel available



#### Engine Specifications WSG850. Ford 5.0L – V8 cylinder.

- ▶ Engine Type...... V-8, DOHC, 4 cam phasers
- Bore and Stroke...... 3.661"x3.649"
- Displacement...... 5.0L (305 CID)
- Compression Ratio...... 12:1
- Net Weight...... 453 Lbs. w/acc.
- Basic Dimensions..... L 31.5"x W 31.4"x H 30.7"
- Certified on Gasoline, LPG, and NG fuels.
- EPA & CARB certified.
  - 800 3200rpm
- SAE 3 Housing and SAE 11.5" flywheel available



#### Engine Specifications WSG873. Ford 7.3L – V8 cylinder.

- ▶ Engine Type..... V–8, SOHC
- Bore and Stroke...... 4.22" x 3.97"
- Compression Ratio...... 10.5:1
- Net Weight..... 580 Lbs.
- Basic Dimensions..... L25.4" x W29.5"x H29.4"
- Certified on Gasoline, LPG and NG
- EPA and Stage 5 Certified.
  - 800 3200rpm

SAE 3 Housing and SAE 11.5" flywheel available



### What are You Guaranteed to Learn

- Morning
- I) Find editechinfo.com website and use all the information.
- > 2) Use the Engine Diagnostic Manual.
- > 3) Use Engine Manuals for operator, service and parts.
- 4) Load Econtrols EDIS software on your laptop.
- > 5) Log onto Econtrols EDIS software, get green connect.
- Afternoon
- ▶ 6) Reprogram .mot files.
- 7) Dataplot required for engine health parameters.
- 8) Find engine specific software name loaded on Main page.
- > 9) Find engine specific DTC's on Fault page & clear them.
- > 10) Download Engine ECM Details file.
- 11) Learn the steps and tools in tele-engine support.



#### Breakdown of the morning quizes

- Quiz1 Vince G from Artic Circle on Heater.
- Quiz2 Using Manuals for Debug.
- Quiz3 Using Schematics for Debug.
- Quiz4 Larry R from Airline Manlift Atlanta.
- Quiz5 No Start Service Call
- Quiz6 Dan C from Montana on Genset.

#### Opening Quiz1-Vince G Artic Circle

- Dealer Calls cell Friday Night 5:30pm from Artic Circle on a down Ford Propane Heater – Engine Runs Rough & Getting Cold Outside.
- Ambient down to -65F / -55C in winter.
- Reporting SPN 723 FMI 2 on operator panel.
- Reporting SPN 731 FMI 15 on operator panel.
- What is the 1<sup>st</sup> thing we do?
- How do we proceed troubleshooting this call?



#### Why are we here? Why do we care?

- Your Company is a Strong Ford Engine OEM customer. EPA, CARB & Stage 5 are tough emissions standard to meet.
- ▶ Ford 3.5L LSG635, V–6, 2008–current.
  - Followed from the ford 3.7L block with direct injection.
  - 2 Overhead Cams Intake and Exhaust Cams with VVT, Intake & Exhaust Cam Phasers. Used in Transit Vans.
- ▶ Ford 7.3L WSG873, V-8 2022-current.
  - Pushrods Engine on Single Camshaft, 1 Cam Phaser, VVT.
  - Designed as a Gasoline Super Duty Truck Engine.
  - Torque Curve Designed around Diesel for heavy trailers.
  - 60% of Ford Profits come from Super Duty Trucks.



# Objectives for this Morning's Training Session.

- Use the EDItechinfo.com website for all debug material and work.
- Debug from Operator Panel Displayed SPN FMI.
  - DTC codes
  - Fault Trees
- Use the EDI Manuals by Engine: Parts, Operators, Service to find parts, torques, and review service procedures.
- Debug Engine Harnesses from the Engine Schematic.
- Find the Required Tools for EControls EDIS.
- Downloading Extracting and Installing EControls EDIS software.
- Teams or Teamviewer for tele-engine session.
- Engine Debug Process with Available Tool Set.



### Using the editechinfo.com website.

Public Access for all Industrial Ford Service Providers: OEM, Dealers & End Users.





# editechinfo.com website

POWERTRAINS INFORMATION

N PUBLIC INFO

INFO DIAGNOSTIC SOFTWARE

More

**Q** Search Site

#### "More" & "About Us"

 Founded company on the ford 300 straight 6. One coil wire with starter and key switch. Vacuum spark advance and distributor points with condenser.

#### "Public Info"

 Access for all Industrial Ford Service Providers: OEM, Dealers & End Users. All Engine Manuals Including Diagnostic, Operators, Service, Parts, Engine Schematic and 42-Pin Ford Customer Interface Connector Definition.



# editechinfo.com website

- "Service Diagnostics"
- Our Training Material
- 4G-GCP Diagnostic Manual.
  - FMI SPM related to DTC.
  - Fault trees.
  - Quiz2.
- Manuals by Engine Model.
  - Parts Manual.
  - Service Manual.
  - Operator Manual.
  - Engine Harness Schematic. Quiz3
  - Body Side 42-pin Engine Pin Out. Quiz3.



# Quiz 2 Using Manuals Provided

- What is the Diagnostic Trouble Code Mean in English?
- What are the Legs of the Fault Tree?
- What engine System is Involved?
- What are the Components Involved?
- How do we proceed?
- Team1 DTC11 what are the SPN & FMI?
- Team2 SPN94, FMI 1 what is the DTC?
- Team3 SPN110, FMI 15 what is the DTC?



#### Quiz 3 Using Harness Schematics

- Team1 What color wire is the signal wire for pre catalyst O2 sensor on the ford wsg873?
- Team 2 What are the wire colors for injector 3 and coil over 3 on the lsg635 gasoline.
- Team 3 What is the function of fuse F5 and what electrical components are protected on the wsg873.
- All 4 groups what pin on the ford 42 pin customer interface is the start command from the body controller? What 2 pins are the minimum required for spark ignited ford engines.



#### Quiz4-Larry R Airline Maintenance Lift Atlanta

- OEM sends email Monday on NO Crank. No Start at Atlanta Hartsfield.
- Machine Serial Number APX16LP1171.
- Reporting SPN 722731 FMI 31 on operator panel controller.
- What is the 1<sup>st</sup> thing we do?
- How do we proceed troubleshooting this call?



# Loading Econtrols EDIS Software

## **Econtrols EDIS "Diagnostic Software"**

- What generates the DTC codes and how do we read them?
- Required Hardware
  - Windows 10 laptop. \$158 USD each as reman government Lenovo T420, T460, T480
  - Econtrols Dongle Part #5080050 ECOM2.
  - Hot Spot Cell Phone if no WIFI and teams is required.
- ▶ GCP Diagnostic Software for all 6.8L v-10.
- AG Rev 582E Diagnostic Software. Rev A-F ECMs. 2.5L, 3.5L, 6.2L and 7.3L.



# editechinfo.com website

- ▶ 4G Rev 661B "Diagnostic Software".
  - Current Revision 661B.
  - Download, Extract, and Install.

MIS

- Volume
- Display
- ECOM Driver

Password



EDIS 661B Volume.zip

Latest\_4G\_Display\_661.zip

205.22 MB

4G Display Update Rev 661



# Connecting to Econtrols EDIS Diagnostic Software

# Engine Display Interface Software (EDIS)

- GCP (Global Control Platform) and 4G Display
  - Purpose
    - Real time engine data with plotting capabilities
    - Display / retrieve fault code information
    - Reprogramming the 4G ECM.



EControls	Main Not Connected	- 🔐 🗲		Error opening ECom modu 251)	ule in HandleConnect, (error code
4G Control Platform Mardod Presare 150 250 00 350 00 psia Batey Vokage 100 220 00 00 vots	Coolart Temp) 8 250 - 250 - 150 - 150 - 50 - 0 deg F Foot Pedal P 100 - 80 - 0 - 40 - 20 - 20 - 150 -	take Ar Temp Oil P 250- 100- 100- 50- 0- 200- 40- 200- 0 deg F 00- 00- 200- 0 deg F 00- 00- 00- 00- 00- 00- 00- 00	essure Systh - - - - - - - - - - - - -	Image: Number of the second	vots vots
Customer Configur Cust advare name/number Cust software name/number Cust data 1 name/number Cust data 2 name/number Cust governor cal name Cust governor cal name Cust governor cal date Engine manufacture date	o o o o o o o o o o o o o o o o o o o	%      0      %        Software m      Initial call        Initial call      Current call        Current call      Current call        Current call      Current call	Ol presure stat Active governor Active	te OK rtype None mode Disabled Information are model number 0 neter 0.000 hour ators starts 0 starts	:

Desktop logo and Main page



# Here are the passwords to connect.

- For older MOT files, the old passwords will still work exactly as before
  16-character password: B0ZW-VYVO-WNVO-FKVP
  - For nower MOT files, on undeted necessary will be re-
- For newer MOT files, an updated password will be required
  - 26-character passwords: WVMLDWK00KHG3-HJGJEBLAP3HJI

📕 Enter Tar	rget Password		×
Password:	·····		-
	Save target password		
	Clear Password		
	Paste Password	Quit	

# Cable & Dongle

Serial connection to the PC
 Can use a USB to serial adapter if needed

Connector below attaches to adapter located on the engine harness



Figure 18: 4G connector



### **Green Connected Button**

*E* EDIS ECI Target Communications



# editechinfo.com website

- German Teamviewer Program.
  - 4 levels to use.
  - 30-day free trial. Max 45 minutes.
  - 3 inputs to one device. No max time. \$239
  - Unlimited inputs and time to one device. \$649
  - Corporate Accounts 3 to 99 users pricing as quoted.
- Microsoft Teams.
  - Provided with office 365 at no extra cost.
  - No time or user limits.
  - Uses Standard Teams Screen Share.



# Quiz5 NO Start service calls.

- Customer Calls: No Crank No Start, No Codes. Ford MSG425 LP Liquid Propane
  - How do we proceed?
  - 1<sup>st</sup> step body side?
  - 2<sup>nd</sup> step body side?
- Customer Calls: Cranks, No Start, No Codes. Ford LSG635 LP.
  - 1<sup>st</sup> step body side.
  - 2<sup>nd</sup> step engine cranking.
  - 4<sup>th</sup> step engine side key ON.



## Information for Quiz5 NO Start.

- Fuel.
- Spark.
- Air.
- Timing Crank Cam.
- Compression.
- What order do we check?
- What are the diagnostic codes involved?



## Exercise

- Check your computer for 661B display software.
- If Not Download the correct revision.
- Take your Dongle and get connected in the engines in workshop.
- Green Connected Light must be on.
- Go to PAGES across the top and Click.
- What are the 6 drop down tabs on the PAGES tab.



# Lunch and already completed

- COMPLETED Find editechinfo.com website and use it.
- COMPLETED Use the engine diagnostic manual.

- COMPLETED –Use Engine manuals for operator, service and parts.
- COMPLETED Load Econtrols EDIS software on your laptop.
- COMPLETED Log onto Econtrols EDIS software, get green connect box, findthe faults tab.



# Quiz6 Dan C Genset Debug

#### Sends an Email from customer in Montana.

- It will start and run at 1500 rpm then shuts down. NG Fuel supply has been thoroughly vetted out and is 100% in spec. (Fuel pressure, line diameter & length etc.)
- It is throwing 2 codes: DTC 1171 -SPN 520260 FMI 0 HIGH and -SPN 520260 FMI 12 OC 0 BAD EE (Unsure whether this second code is DTC 1176, 1177, or 1178.)
- What are the next steps in trouble shooting this problem?


# Afternoon Agenda

- Fuel systems
  - Gaseous fuel systems. LP, PG and NG.
  - Gasoline Fuel systems,
- Exhaust System
- ECU & Engine Harness.
- Getting On & Using EDIS.
- Pages MAIN & FAULTS.
- Reviewing and Clearing Faults.
- Download and Analyze ECM Details.
- Reprogram Target.
- Dataplot up to 20 Engine Health Parameters.

#### **Fuel Systems** Gaseous and Gasoline

### **Fuel Systems**

- Two Types of Fuel Systems Utilized
  - Liquid Fuel
    - Unleaded Gasoline (87 or 89 octane)
    - E10
  - Gaseous Fuel
    - LP Vapor (2516 btu/ft\*\*3)
    - LPG (HD-5)
    - Natural Gas (1050 btu/ft \*\* 3 )
    - CNG

#### **Gasoline Fuel System** Fuel Pressure Тο Fuel Sensor Injectors System consists of Fuel block Fuel Pump Time are en • Fuel filter T. M. Fuel pump Fuel Filter Fuel Rail Return to Tank Fuel injectors Fuel Rail From Tank Injectors Figure 6: Gas Fuel system

### **Gasoline Fuel System**

- Fuel block provides fuel temperature and pressure readings to ECU
- Fuel pump is PWM controlled based on the pressure reading from fuel block

<u>File Page</u> Flash <u>C</u> omm Port P <u>l</u> ot/Log Settings Help					
Faults    O    Connected    O    O    Connecting to target (12)    USB CAN connected at 250 kbps (SA=0)					
Fault Access	Closed-Loop Control	System States	Monitored Drivers	Diagnostic Modes	Derates / Warnings
Engine Speed  0  rpm    Manifold Pressure  14.54  psia    Barometric Pressure  14.52  psia    Coolant Temperature  64.5  deg F    Cylinder Head Temp  64.5  deg F    Intake Air Temperature  70.7  deg F    Spark Advance  1.8  BTDC    Pulse width  49.2  ms    Fuel rail pressure - Pet  16.0  nsia	Closed-loop 1      0.0      %        Closed-loop 2      0.0      %        Post-cat CL offset      0.00      %        Adaptive 1      0.0      %        Adaptive 2      0.0      %        EGO 1      0.010      volts        EGO 2      0.000      volts        EGO 3      0.012      volts        EGO 4      0.000      volts        Itim duty-cycle      0.0      %	Run Mode      Stopped        Power Mode      Key off        Fuel Type      Gasoline        End Supply      Pee        Fuel/Spark inhibit input      Normal        Fuel Control Mode      Open Loop        Governor switch state      None        Active governor type      Min        Active governor mode      Isochronous	Injector-on Order Number      Injector-off low-side votage      Spark Coll dwell ms        1      1      0.0      0.0      2.50        2      3      0.0      0.0      2.50        3      4      0.0      0.0      2.50        4      2      0.0      0.0      2.50        5      X      0.0      0.0      2.50        6      X      0.0      0.0      2.50        7      X      0.0      0.0      2.50        8      X      0.0      0.0      2.50	Spark kill Normal	Derate 1 Derate 2 Low Rev-Lim Forced Idle Shutdown MIL output pin Buzzer output pin Hard warning output Soft warning output Flight Data Base Definitions:
aerTall pressure - Sec      79.7      psia        Seal temperature      84.0      deg E        Gaseous pressure actual      0.00      "H20        Gaseous pressure actual      0.00      "H20        Current governor target      1200      rpm        Engine Load      88.0      %        Current estimated torque      0.0      N-m	BWA & FPP Variables        command      30.0 $\chi$ TPS position      5.1 $\chi$ TPS1 percent      5.1 $\chi$ TPS2 percent      2.2 $\chi$ TPS1 voltage      0.793      voltage        TPS2 voltage      4.120      voltage	Oil pressure state      Low - Ignored        Oil pressure config      Low V = OK        IVS state      Off Idle        Input Voltages      Gov1 voltage        Gov2 voltage      0.4	Image: Second	fuel_type_u16      A_BM2        run_tmr_sec      Vbat        rpm      FPP_pct        rMAP      TPS_pct        rECT      EGO1_volts        rIAT      EGO2_volts        CL_BM1      PW_avg        CL_BM2      TRIM_DC	rpm CL_BM2 rMAP Vbat FPP_pct PW_avg TPS_pct A_BM1 CL_BM1 A_BM2
Current estimated torque      0.0      %        V battery      12.2      volts        V switched      0.0      volts        Hour meter      105.901      hours        MIL total on-time      0.370      hours        Cumulative starts      732      starts	FPP command      0.0      %        FPP position      0.0      %        FPP1 voltage      0.000      volts        FPP2 voltage      5.000      volts        I/VS voltage      5.000      volts	Oil pressure voltage  0.4  Volts    Oil pressure voltage  4.9  volts    MAP voltage  4.0  volts    ECT/CHT voltage  3.3  volts    IAT voltage  2.6  volts	Fault shutdown inhibit Aux DIG config Default v Fault adaptive learn disable Fuel Download ECM Details View/Set Fault Parameters View Previously Pending Faults	A_BM1      HM_hours        SnapShot Custom Definitions:      EMPTY        EMPTY      EMPTY	Flight Data Custom Definitions:

#### **Fuel Injectors**

- Each injector has a red wire
  - Supplies 12 volts from relayed power
  - Always on when cranking and running
- Color wires are ground pulses from ECU
  This triggers the fuel injectors to spray
- Timing is preset in the ECU

#### System Requirements

- Low permeable fuel lines
  - Imperative customers use the EDI supplied fuel line and fittings
- Fuel tank must be made out of metal or a coextruded highdensity polyethylene fuel tanks with a continuous ethylene vinyl alcohol barrier layer
- Clamps on high pressure hose must be crimped with Oetiker pincers, model 1098i or model 1099i.
- A tethered or self-closing gas cap must be used. The fuel cap should incorporate a purge valve that stays seated up to a positive pressure of 24.5 kPa (3.5 psig) and a vacuum pressure of 0.7 kPa (0.1 psig).

### Vapor Lock

- Most prevalent issue EDI is facing on installs.
  Bottom draw tank with fuel pump first and away from heat sources. Then filter and fuel block.
- EPA defines that at 85°F ambient and fuel temperature of 127°F the unit will vapor lock
- Adding parameters to application review to record relevant data that exposes a vapor lock condition

#### **Gaseous Fuel Systems**

- LPG System
- LP Vapor System
- Natural Gas System
- CNG System

# LPG Fuel System

- Liquefied Petroleum Gas (LPG Grade HD-5)
  - Propane is vaporized and pressure reduced
  - Pressure is regulated with an Electronic Pressure Regulator (EPR)
  - Fuel goes to the mixer where it is mixed with air and then goes through the throttle and into the intake air manifold



# LPG Fuel System

#### Consists of

- Dry Fuel Mixer
- Electronic Pressure Regulator
- Vapor Regulator
- Lock off Valve

#### This is true for all current EDI Ford engines

- MSG425 utilize the same components for their LPG fuel system
- WSG873's components are the same as the smaller displacement engines except larger in scale



#### LPG System Picture



#### Natural Gas Fuel System

- 1050 btu/ cu ft is supplied to the engine at 11 inches of water columun
  - Pressure is then regulated with an Electronic Pressure Regulator (EPR)
  - Fuel goes to the mixer where it is mixed with air and then goes through the throttle and into the intake air manifold



Natural Gas pressure to DEPR = 11" W.C.

Same for whole product line regardless of engine size



#### Natural Gas System Pict



# **CNG and LP Vapor**

Fuels stored at higher pressures

- LP Vapor Propane already in a vapor state; typically at 300psi
  - Setup is similar to natural gas.
  - low pressure lock off valve
  - Pressure needs to be reduced to 11" W.C. before reaching the electronic pressure regulator
- CNG Natural stored at ~3000psi.
  - Similar to LPG setup; high pressure lock off valve
  - Pressure needs to be reduced to ~100-300psi before entering supplied regulator on engine

# DEPR (Direct electronic pressure regulator)



TSG416



#### DEPR (Direct Electronic Pressure Regulator)

- Actuator in the EPR controls the fuel pressure to the mixer
  - Actual "delta P" matches the 4G command
- Extremely accurate open loop type of fuel control
- After preset amount of time (50 seconds), engine goes to closed loop control
   Uses information from the pre and post cat oxygen sensors to allow further adjustment to meet emission regulations



# **Dry Fuel Mixer**

- Device by which fuel can be added to passing air flow
- Amount of fuel is related to amount of air passing through the mixer
- This is controlled by the differential pressure across the diaphragm
- More air the engine demands the lower the pressure in the throat is which relates to the diaphragm
- Diaphragm overcomes the spring force holding it down to allow more fuel to mix with the air



# Lock Off Valve

- 12 volt DC Solenoid driven valve located before the EPR or vapor regulator
- Only open when the engine is starting and running
- When user initiates engine shutdown, the valve closes
  - Prevents fuel from getting to the intake system
  - Engine will continue to run for about 3 seconds to use up the remaining fuel in the manifold
  - Prevents an engine backfire from occurring during the next startup
- Referred to as Fuel Run–Out
- Low pressure valve used for NG/LP Vapor
- Higher pressure valve used for LPG/CNG



# Lock Off Valve Positioning

- Lock off should be placed as close as possible to vapor regulator (LPG) or DEPR (NG)
  - This will reduce fuel run-out time



LPG Vapor Regulator





# **Dry Fuel System Review**

- Vapor Regulator (Vaporizer)
  - Used on LPG only
  - Fuel from tank connects directly
  - Combined with the EPR on the 2.3L
  - Separate on all other engines
- (D)EPR (Electronic Pressure Regulator)
  - Precisely controls the fuel into the engine
  - Used for both LPG and NG
  - 11" W.C. to EPR on NG
- Lock Off valve
  - Prevent fuel from building up in the intake which could cause a backfire
- Mixer
  - Where the fuel from the EPR is mixed with air
- Governor
  - After the fuel and air is mixed the governor regulates the mixer into the air intake manifold



#### **Dry Fuel System Installation Notes**

- Position of the vapor regulator to mixer/DEPR is very important
  - Refer to emission install instructions for:
    - Length of LPG hose between vapor regulator and mixer
    - Height relative to mixer
  - If these are not followed this could lead to premature failure of the vapor regulator
    - Could cause oils to build up in vapor regulator and LPG lines
  - Keep Distance of Lock off valve to vapor regulator or DEPR as short as possible



#### Gaseous Fuel Components By Engine

LPG lock off with filter

#### ▶ 2.5L

- E100 Style Mixer
- D19 DEPR
- 3/4" NPT sized low pressure lock off Valve
- 40mm throttle body
- LPG Vapor Regulator LD DSR





LPG Vapor Regulator

#### Gaseous Fuel Components By Engine

#### ▶ 3.5L

- E330 Style Mixer
- D19 DEPR
- 3/4" NPT sized low pressure lock off Valve
- 60mm throttle body
- LPG Vapor Regulator LD DSR



LPG lock off with filter

LPG Vapor Regulator

E23760050° LD DSR LPG SN: 256536

#### Gaseous Fuel Components By Engine

- ▶ 7.3L
  - E480 Style Mixer
  - D28 DEPR
  - 1-1/4" NPT sized low pressure lock off Valve
  - 60mm throttle body
  - LPG Vapor Regulator HD DSR



#### **Exhaust System**



### **Exhaust System**

- Exhaust must be a closed system
  - Emission install instructions list
    - Distance of pre-cat sensor from exhaust manifold
    - Distance of center of catalyst from exhaust manifold
    - Length of solid pipe required after post-cat sensor to avoid false oxygen readings
    - Avoid placing near critical items and fuel sources
  - Ensure oxygen sensors are properly oriented to prevent water from burning out the sensors
  - Use 409 stainless steel pipe or equivalent
    - Must last useful life of engine
    - 7 years or 5000 hours



## **Exhaust Layout Example**



Figure 13: Exhaust layout



# **Oxygen Sensor Positioning**



Must be inclined at least be 10° above the horizontal

Figure 14: O2 Sensor Positioning



#### **ECU Specifications and Circuits**



### **ECU Desingations**

#### GCP (Global Control Platform)

- 1.6L, 2.3L, 2.5L, 6.8L.
- 6.8L will remaining GCP.
- 4G ECU Platform
  - 1.5L, 2,5L,3.7L,3.5L,6.2L,7.3L Rev A, D, F or G.



### 4G/GCP Capabilities

- ► 4G GCP (Global Control Platform)
  - 90 pin computer that connects to the below components on the engine



# GCP/4G Specs

- 12 volt system only (6–18volts)
- IP 67 rated
- -40°F to 225°F normal operating temp.
- Im drop onto concrete surface
- 15 mins. in four inches of water
- 8G vibration at ECM header pins
- 0.005 AMP draw when powered down



### **GCP/4G Features**

- Programmable four speed electronic governing, throttle-bywire or variable speed control governing.
- Programmable emergency warning/shut-down feature for high water temperature, low oil pressure, etc.
- Starter lockout
- Programmable over speed protection
- Automatic altitude compensation
- Sequential port fuel injection (gasoline) with pressure regulator to precisely control fuel delivery
- Certified closed loop dry fuel control
- Configurable outputs available based on ECT, RPM or MAP signals and customer requirements
- Diagnostic software allows viewing of historical and active faults with on-demand diagnostics to assist technicians and reduce equipment downtime.


#### GCP/4G Safety Features

- Protects the user and the engine from hazards such as:
  - Over speed
  - Over temperature
  - Over voltage
  - Low oil pressure
  - Unauthorized tampering
  - Over cranking the starter motor
  - Dry fuel run–out



# GCP/4G Inputs

- Operating conditions being read
  - Engine coolant temperature
  - Exhaust oxygen content
  - Intake Manifold absolute pressure
  - Battery voltage
  - Throttle Position/Electronic actuator
  - Fuel pump voltage
  - Intake air temperature
  - Camshaft position
  - Crankshaft position



# GCP/4G Control

- Throttle
  - 0 5 volts with an IVS
- Potentiometer
  - 0 5 volt input
- Discrete Speed
  - 12 volt signals directly ramp the engine to a set speed
- Tap Up / Tap Down
  - 12 volt signals variably increases or decreases the speed
- J1939
  - Can use TSC1 Commands



# GCP/4G Outputs

- Systems controlled
  - Spark
  - Electronic throttle control
  - Electric fuel pump or Dry Fuel Pressure Regulator
  - Diagnostics Malfunction indicator lamp (MIL malfunction indicator light)
  - Diagnostics Data Link Connector (DLC)



# GCP/4G J1939

- Outputs common J1939 Parameters
  - Throttle position
  - Engine Speed
  - Engine Temperature
  - Oil Pressure (9psi or 99psi with switch)
  - Engine Hours
  - Fuel Consumption
  - Battery Voltage
  - Faults codes via a SPN and FMI #
- Can also take throttle commands via TSC1
  - Address is configurable
    - 3, 39, 17, 208 and 234



#### **Closed Loop Control**

 ECU monitors the output of the engine and makes changes so the desired output is achieved



# **Closed Loop Fueling**

- Certain conditions must be must
  - Coolant temp of 100 deg[F]
  - Run time of engine, 15 seconds after reaching temp above
- Once closed loop
  - ECU actively monitors the EGO sensor to determine fueling accuracy
  - If it is not accurate it will begin adding or subtracting fuel to achieve a stoichiometric fuel mixture



# Grounding

- Extremely important to have sufficient grounding
- Chassis ground must be on unpainted surface
- Battery ground must be directly to engine block on unpainted surface
- Recommend at least 1 gauge wire size



#### **Distributor Free Ignition System**

- Electronic Distributor less Ignition System (EDIS)
- Individual ignition coils
  - Located directly above each spark plug
  - Ignite the fuel in the cylinders
  - Each coil has a red wire; 12 volts from relayed power
  - Engine ECU provides ground to fire coil (color wires)
- Spark is only allowed when the CAM and crank sensor are detected together





#### 2.5L, 3.5L, 3.7L,6.2L and 7.3L Fuse Box (NO Starter Relay)



Fuse	Amps Circuits protected		
1	10	Battery Voltage to EPR	
2	5	Ignition Voltage to GCP and Relays	
3	10	Battery Voltage to GCP	
4	15	Fuel pump	
5	15	Battery Voltage out of Power Relay	
6	10	0 Alternator E	

#### **Sensor Description**

#### ECT/CHT Sensor

- > 2.5L utilize a ECT sensor
  - Engine coolant temperature direct measurement
  - Both located on back of engine near the coolant outlet
- 3.5L, 3.7L, 6.2L, 6.8L, and 7.3L utilize a CHT sensor
  - Cylinder head temperature measurement
  - Coolant temp. displayed is based off of calculation from CHT measurement
  - 7.3L located underneath the intake manifold towards the front of the engine
- Both sensor types are 0 5 volts



# ECT / CHT

- The 2.5L use an ECT analog temp sensor in the engine to read an analog voltage and make shutdown decisions.
  - At All RPMs.
    - 220F derate stage 1.
    - 225F shutdown stage 2.
- All 3.5L, and 7.3L engines use a CHT analog sensor in the engine to read an analog output voltage and make shutdown decisions.
  - At all RPMs.
    - 225F derate stage 1.
    - 240F shut down stage 2.



#### **TMAP Sensor**

- Intake air temperature and manifold air pressure measurement sensor
- Intake air = ~ambient air temperatures
- MAP = 4psia to 14.7psia
  - The greater the delta from 14.7, the smaller the load
  - The closer to 14.7psia, the larger the load
- Both are 0 5 volt sensors.
- Same sensor used on all Ford NA engines



# **TMAP** Wiring

- Lt.Green/Black MAP signal in
- Brown/White 5 volt reference
- Gray IAT signal in
- Gray/Red 5 volt return
- IAT Pull up type circuit
  - When open the circuit defaults to 5 volts
  - Sensor applies a resistive load between the sensor signal and its ground and brings down the voltage
- MAP Pull down type circuit
  - 3 wire circuit where the signal in and 5 volt circuit are separate. When unplugged the signal defaults to 0 volts
  - A resistive load is placed between the 5 volt circuit and the sensor ground



# **CAM Sensor**

- 2.5L, 3.5L, 6.2L & 7.3L-Hall effect with pull-up
  - Three wire sensors
    - 5 volt reference
    - CAM+: Signal
    - CAM -: 5 volt return
- 3.7L/6.8L Magnetic Pickup
  - Two wire sensor; crank+ and crank-
    - Typical resistance values
      - 1.5L: 0.490 kΩ
      - 3.7L: 1.25 kΩ
      - 6.8L: 0.388 kΩ
    - 3.5L has two CAMs per head
      - EDI only uses the intake CAM sensors

MSG425 CAM sensor resistance					
Measureme	Measurements				
Component	Measurement	Unit			
CAM Sensor: Viewing PINS with sensor side dowr					
	5.2	MΩ			
	OL				
4.6 MΩ					



#### **Crank Sensor**

- 2.5L Magnetic pickup
  - Two wire sensor of crank+ and crank-
    - Typical resistance values
      - 1.5L: 0.43 kΩ
      - 2.5L: 0.452 kΩ
      - 3.7L: 0.680 k $\Omega$
      - 6.8L: 1.3 Ω

2.5L/6.8L - Read off of the front crank pulley
3.5L, 3.7L, 6.2L & 7.3L - Read off crank tooth plate mounted on the flywheel.

#### **Knock Sensor**

Monitors engine noise to prevent pre-ignition

- Two wire sensor knk+ and knk-
  - Typical resistance values
    - 1.5L: Ω
    - 2.5L: 4.8 MΩ
    - 3.7L: MΩ



# Oil Pressure Switch Digital

- All 2.5L, 3.7L, 6.2L, 6.8L engines utilize a normally open switch.
  - Open without pressure
  - Closed with pressure at 7psig.
  - Monitored by ECU and will cause a shutdown if open for 15 seconds when above 650 RPM
  - 0 volts on circuit when running
  - 5 volts on circuit when low or off



#### **Oil Pressure Switch Analog**

- All 3.5L, 5.0L, and 7.3L engines use an analog oil pressure sensor in the engine to read an analog voltage & make shutdown decisions.
  - RPM<1200 at idle.
    - 15 psig derate stage 1.
    - 5psig shut down stage 2.
  - RPM > 1200 at run.
    - 20 psig derate stage 1.
    - 10 psig shut down stage 2.



# VVT- Variable Valve Timing

- Ford uses VVT on the intake valve timing.
- Electronically controlled hydraulic valves that direct high pressure engine oil into the camshaft phaser cavity
- ECM PWM signal to the solenoids to move a valve spool that regulates the flow of oil to the phaser cavity.
- The phaser cavity changes the valve timing by rotating the camshaft slightly from its initial orientation, which results in the camshaft timing being advanced or retarded.
- The ECU adjusts the camshaft timing depending on factors such as engine load and RPM



#### VVT Variable Valve Timing Solenoid

- Constant 12volts on hot side; at initial key on, cranking, and running
- Ground is PWM Controlled
- Will report through DTC 11: Intake cam position error
  - Typically, a result of the positive or PWM wire being disconnected
- LSG635 CSG637 has twin solenoids on each head. EDI only uses the intake solenoids. Exhaust remain unconnected.



### **ECU Diagnostics**

#### What are the Afternoon Objectives?

- Find the Engine Calibration Part Number, Revision Number and Fuel Type. (MAIN Page)
- Reprogram a Target Engine with a Calibration. (FILE Dropdown Menu)
- Dataplot a Running Engine. (PLOT / LOG Dropdown Menu)
- Review and Clear Engine Faults. (FAULTS Page)
- Load ECM Details. (FAULTS Page)



#### **Connect to EControls EDIS**



- For older MOT files, the old passwords will still work exactly as before
   16-character password: B0ZW-VYVO-WNVO-FKVP
- · For newer MOT files, an updated password will be required
  - 26-character passwords: WVMLDWK0OKHG3-HJGJEBLAP3HJI

🗲 Enter Ta	rget Password		$\times$
Password		- [******	
	Clear Password		
	Paste Password	Quit	)





# **Drop Down Menus**





#### Drop Down Menu Description.

- Menus located on top of the screen
  - File Menu: Used primarily to perform disk and file management functions.
  - **Page Menu**: Used to select the active page and configure which pages will be visible for use during a software session.
  - Flash Menu: Commits updated calibration variables to flash memory
  - **Comm Port Menu**: Selects the PC's active serial communication port and displays communication statistics.
  - Plot/Log Menu: Graphically plots or numerically logs static and dynamic variables and metrics that have been tagged for plotting or logging. Tag by right clicking a variable.
  - Settings Menu: Change Settings in EDIS for Specific Operation. communication statistics.

# **FILE Drop Down**

#### File Drop Down: Reprogram Target

D

#### EDIS ECI Target Communications

EIN Page Flash Comm Port Plot/Log Settings Help

Save Calibration to Disk	RawVolts		Connecting to target (12 USB CAN connected at 2	) 250 kbps (SA=0)			
Clear Cal Tags					<u> </u>		
Convert Ontent	Voltage Supplies	Aux Analog	Inputs	Aux Digital Inputs		Aux PWM Output Fee	dback
Bulk Reprogram	Valtemator_raw	2.500 volts AUX_PU1_rav	v 2.686 volts	GOV1_raw 0.484 v	olts	AUX_PWM1_FB_raw	0.000 volts
Print Popol	Vbat_raw	2.151 volts AUX_PU2_rav	v 5.000 volts	GOV2_raw 0.486 v	olts	AUX_PWM2_FB_raw	0.000 volts
<u>Finit Faner</u>	VE5a_FB_raw	4.545 volts AUX_PU3_rav	v 5.000 volts	A/D Raw	Header	AUX_PWM3_FB_raw	0.000 volts
Exit Ctrl+X	F VE5b_FB_raw	4.546 volts			2.75 volts	AUX_PWM4_FB_raw	0.000 volts
Manifold Temperature	VE5c_FB_raw	4.545 volts AUX PD2 raw	0.753 volte		2.73 volts	AUX_PWM5_FB_raw	0.000 volts
Interve Air Temperature 72.2 dee	F VE6_FB_raw	3.000 volts AUX PD3 raw			2.73 volts	AUX_PWM6_FB_raw	0.001 volts
Tritake Air Temperature 72.3 deg	UEGO_Vcc_raw	4.545 volts		AUX DIG4 raw 0.486	2.75 volts	AUX_PWM7_FB_raw	0.000 volts
Vbat 12.2 volts	Vrelay_raw	0.000 volts AUX_PUD1_ra	aw 0.000 volts	AUX_DIG5_raw 0.442	2.50 volts	AUX_PWM8_FB_raw	0.000 volts
Vsw 0.0 volts	Vsw_raw	0.001 volts AUX_PUD2_ra	aw 4.634 volts	AUX DIG6 raw 0.442	2.50 volts	AUX_PWM9_FB_raw	0.000 volts
Vrelay 0.0 volts	ref_4096V_raw	4.096 volts AUX_PUD3_ra	aw 0.000 volts	AUX DIG7 raw 0.442	2.50 volts	AUX_PWM10_FB_raw	0.000 volts
Primary 5V external 5.0 volts	Misc Engine Sensors	AUX_PUD4_ra	aw 2.500 volts	AUX DIG8 raw 0442	2.50 volts	AUX_PWM11_FB_raw	0.000 volts
Secondary 5V external 5.0 volts	T internal raw	AUX_PUD5_ra	aw 2.500 volts	AUX DIG9 raw 0442	2.50 volts	AUX_PWM12_FB_raw	0.000 volts
Tertiary 5V external 5.0 volts	FCT raw	3 211 volts AUX_PUD6_ra	aw 2.500 volts	AUX DIG10 raw 0442	2.50 volts	AUX_PWM13_FB_raw	0.000 volts
Gov1 voltage 0.4 volts	EGT raw	2.500 volts AUX_PUD7_ra	aw 2.500 volts	AUX DIG11 raw 0.442	2.50 volts	AUX_PWM14_FB_raw	0.000 volts
Gov2 voltage 0.4 volts	FPP1 raw	0.000 volts AUX_PUD8_ra	aw 2.500 volts	AUX DIG12 raw 0.442	2.50 volts	AUX_PWM15_FB_raw	0.000 volts
Oil pressure voltage 4.9 volts	FPP2 raw	5.000 volts AUX_PUD9_ra	aw 2.500 volts	AUX DIG13 raw 0.442	2.50 volts	AUX_PWM16_FB_raw	0.000 volts
laisatan laisatan an laisatan aff	FRP raw	0.753 volts AUX_PUD10_	raw 2.500 volts	AUX DIG14 raw 0.442	2.50 volts	AUX_PWM17_FB_raw	0.000 volts
Firing Cylinder low-side low-side	FT raw	2.686 volts AUX_PUD11_	raw 2.500 volts	AUX DIG15 raw 0.442	2.50 volts	AUX_PWM18_FB_raw	0.000 volts
Order Number voltage voltage	IAT_raw	2.585 volts AUX_PUD12_	raw 2.500 volts	AUX_DIG16_raw 0.442	2.50 volts	AUX_PWM19_FB_raw	0.000 volts
1 1 0.0 0.0	IVS_raw	5.000 volts AUX_PUD13_	raw 2.500 volts	AUX_DIG17_raw 0.442	2.50 volts	AUX_PWM20_FB_raw	0.000 volts
2 3 0.0 0.0	MAP_raw	3.974 volts AUX_PUD14_	raw 2.500 volts	AUX_DIG18_raw 0.442	2.50 volts	AUX_PWM21_FB_raw	0.000 volts
3 4 0.0 0.0	OILP_raw	4.999 volts AUX_PUD15_	raw 2.500 volts	AUX_DIG19_raw 0.442	2.50 volts		0.000 volts
4 2 0.0 0.0	TIP_raw	0.000 volts AUX_PUD16_	raw 2.500 volts	AUX_DIG20_raw 0.442	2.50 volts	AOV_LANWS2_LP_Lam	0.000 voits
5 X 0.0 0.0	TPS1_raw	0.794 volts AUX_PUD17_	raw 2.500 volts	AUX_DIG21_raw 0.442	2.50 volts	Common-Rail Injection	Hardware
6 × 0.0 0.0	TPS2_raw	4.170 volts AUX_PUD18_	raw 2.500 volts	AUX_DIG22_raw 0.442	2.50 volts	CRI1_boost_raw	0.000 volts
	_		raw 1 2 h00 volts	<u></u>		0001	0.000 1

# File Drop Down

#### File Types

- Calibration File (.CAL)
  - Static variables
  - Not the entire calibration
  - Use "Load Calibration from Disk" to upload

#### MOT File (.mot)

- Full calibration
- Embedded software algorithms
- Necessary to completely configure the GCP
- Can not be viewed or executed on a PC
- Use "Reprogram Target" to upload



#### **Reprogram Target**

- Reprograms the 4G microprocessor with a binary MOT file that contains the full calibration and embedded software control algorithms.
- Performed when software modifications have been released or a full calibration is needed to be loaded



#### Find the .MOT file to load



# Go to File ->Reprogram Target

- Locate the .mot file on your PC
  - Click Ok
- Then follow these prompts
  - Clicking Yes





Figure 23: Prompts



#### After the Progress Bar Reaches 100%

/ Ta	rget Re	progra	ım Proj	gress	X
Repro	ogramming			2	3.0 %
, 0.0	, 20.0	40.0	60.0	1 80.0	100.0
		Car	ncel		



Figure 24: Successful .MOT load Recycle Power to Run New Program.



#### **Reprogramming Target**

- If there is an error while uploading the MOT file, you will receive this prompt
  - Try reloading again
  - If it continues to fail contact EDI

Target Not Programmed!
The target is in special bootstrap mode and needs to be programmed. After clicking OK, choose a Motorola S record file to download to the target. Click CANCEL in the next dialog box to exit
<u>O</u> K

Figure 25: Unsuccessful MOT load prompt


# PAGE Drop Down

#### PAGE Drop Down Menu



# PAGE Drop Down

- We will be working with the following pages.
  - MAIN Page for Calibration Information.
  - FAULTS Page to identify engine FAULTS, clear engine FAULTS, and download ECM Details.
  - RAW VOLTS use as a digital volt meter to find sensor voltage read by the computer in DC volts.

# Flash Drop Down

#### Flash Drop Down



# Flash Drop Down

- Commit Dirty Page Commit Recent Calibration Changes (Dirty Flash) to 4G Memory.
- Release Dirty Page Return Calibration to Original State.

# **COMM Port Dropdown**

#### **Comm Port Drop Down**

Elle Page Flash	Automatic COM COM1 COM2		<b>→</b> C	REC	Connecting to target (12) JSB CAN connected at 250 kbps (SA=0)
Fault Access Fagine Speed Manifold Pressure Barometric Pressure Coolant Temperature Cylinder Head Tamp Manifold Temperature Intake Air Temperature Spark Advance Pulse width Fuel rail pressure Gaseous pressure Gaseous pressure Gaseous pressure tame Gurrent estimated torque V battery V switched Hour meter MIL total on-time Cumulative starts	COM2 COM3 COM4 COM5 COM6 COM7 COM8 CAN - ifak system USB Configure CAN ECOM Configure CAN ECOM Configure ECOM Remote EDIS Burst Mode Dump Call Dat Info Show Stats Enhanced Security Statu Enhanced Security Represt Configure TCP. FPP command 12.2 volts 0.0 volts 105.928 hours 105.928 hours 734 starts	trol           0.0         %           0.0         %           0.0         phi           0.0         %           0.0         %           0.0         %           0.0         %           0.0         %           0.0         volts           00         volts           00         volts           00         volts           0.0         %           Ctrl+B         ables           F8         0.0           Ctrl+S         5.1           Ctrl+R         2.2           93         volts           0.0         %           0.0         %           0.0         %           0.0         %           0.00         volts           5.000         volts           5.000         volts	System St Run Mode Power Mode Fuel Type Fuel Supply Fuel/Spark inhibit input Fuel Control Mode Governor switch state Active governor type Active governor mode Brake pedal status Oil pressure state Oil pressure state Oil pressure config IVS state Input Volta Gov1 voltage Gov2 voltage Oil pressure voltage MAP voltage ECT/CHT voltage IAT voltage	ates         Stopped         Key-off         Gasoline         Off         Nomal         Open Loop         None         Min         Isochronous         Depressed         Low - Ignored         Low V = OK         Off Idle         ges         0.4       volts         0.4       volts         4.9       volts         3.3       volts         2.8       volts	Monitored Drivers       Diagnostic Modes         Injector on Injector off Order Numside voltage voltage voltage       Spark kill Normal voltage       Derates / Warnings         1       0.0       0.0       2.50         2       3       0.0       0.0       2.50         3       4       0.0       0.0       2.50         4       2       0.0       0.0       2.50         5       X       0.0       0.0       2.50         6       X       0.0       0.0       2.50         7       X       0.0       0.0       2.50         8       X       0.0       0.0       2.50         9       X       0.0       0.0       2.50         9       X       0.0       0.0       2.50         9       X       0.0       0.0       2.50         10       X       0.0       0.0       2.50         9       X       0.0       0.0       2.50         10       X       0.0       0.0       2.50         10       X       0.0       0.0       2.50         Fault action persist mode       Cycle       Fault action persist MIL       Disabl
					View Cleared Faults

## **Comm Port Menu Functions**

- Allows the user to select the PC's active serial port and provides information about communication statistics
- Automatic (Default): Permits the software to cycle through available RS-232 serial communication ports until a connection is established with a target.
- COM1, COM2, etc.: Specifies which communication port to connect through for a given software session. This setting is not retained once the software has been exited.
- Show Stats (Ctrl+S): Displays communication statistics between the PC and ECM once a connection has been established Statistics include serial baud rate, transmit and receive loads, and time information.



# Plot / Log Dropdown

#### Plot/Log Drop Down Menu

E EDIS ECI Target Communications			- 0
File Page Flash Comm Por Plotilog Settings Help			
Clear Tags Plot Tags Log Tags Cth-P Cth-L	Connecting to target (12) USB CAN connected at 250 kbps (SA=0)	 	
Log Tags       Ctrl L         Fault Access       New Mark       Ctrl+ I         Engine Speed       np       Marks       Ctrl+Shift+II         Engine Speed       np       Marks       Recorder Settings         Barometric Pressure       1445       pt       Load Recorder Settings         Coolant Temperature       660       dt       Load Recorder Settings         Colant Temperature       663       dt       Load Recorder Settings         Quinder Head Temp       66.3       dt       Load Recorder Settings         Manifold Temperature       66.3       dt       Load Car Cor Z         Intake Air Temperature       66.3       dt       Load Z       Outer Vons         Spark Advance       1.7       BTDC       EGO 4       0.000       volts         Pulse width       46.8       ms       Attemate-Fuel       0.0       %         Fuel rail pressure - Pri       15.9       psia       DBWA & FPP Variables         Fuel rail pressure - Sec       79.7       psia       DBWA & FPP Variables         Fuel rail pressure actual       0.00       "H20       TPS position       5.1       %         Gaseous pressure actual       0.00       "H20       TPS p	REC         System States         Run Mode       Stopped         Power Mode       Key-off         Fuel Type       Gasoline         Fuel Supply       Off         Fuel Supply       Off         Fuel Control Mode       Open Loop         Governor switch state       Nomal         Active governor type       Min         Active governor mode       Isochronous         Brake pedal status       Depressed         Oil pressure state       Low - Ignored         Input Voltages       Fault action persist mode       Cycle         Fault action persist MIL       Disabled	Diagnostic Modes      Spark kill Normal     Injector kill Normal     DBW test     Off     DBW test     Off     Dff     External power     Automatic     Cylinder numbering     Firing Order      SnapShot Base Definitions:     fuel_type_u16     A_BM2     run_tmr_sec     Vbat     rpm     FPP_pct     rMAP     TPS_pct     rECT     EG01_volts     rIAT     EG02_volts     CL_BM1     PW_avg     CL_BM2     TRIM_DC	Derates / Warnings         Derate1         Derate2         Low Rev-Lim         Forced Idle         Shutdown         MIL output pin         Buzzer output pin         Hard warning output         Soft warning output         Fight Data Base Definitions:         pm       CL_BM2         MAP       PW_avg         FPP_pct       A_BM1         CL_BM1       A_BM2
Current estimated torque     0.0     %     FPP command     0.0     %       V battery     12.2     volts     FPP command     0.0     %       V switched     0.0     volts     FPP position     0.0     %       Hour meter     105.901     hours     FPP2 voltage     5.000     volts       MIL total on-time     0.370     hours     IVS voltage     5.000     volts	Oil pressure voltage     0.4     volts     Fault shutdown inhibit Aux DIG config     Default       Oil pressure voltage     4.9     volts     Fault shutdown inhibit Aux DIG config     Default       MAP voltage     4.0     volts     Fault adaptive leam disable     Fuel       ECT/CHT voltage     3.2     volts     Download ECM Details       IAT voltage     2.6     volts     View/Set Fault Parameters       View Previously Pending Faults     View Previously Pending Faults	A_BM1     HM_hours       SnapShot Custom Definitions:       EMPTY     EMPTY       EMPTY     EMPTY       EMPTY     EMPTY       EMPTY     EMPTY       EMPTY     EMPTY       EMPTY     EMPTY	Flight Data Custom Definitions: EMPTY EMPTY

\*Tagged variables shown in green



# Plot/Log Menu Functions

- Allows the user to graphically plot or numerically log variables that have been tagged for plotting/logging
- To plot or log variables, a tag must be assigned to each variable of interest
  - Right click over the variable to tag it
  - If a variable is tagged it will be highlighted green
  - Maximum of 20 variables can be tagged for logging and plotting



# Plot/Log Menu Functions

- Clear Tags: Releases all plot/log variables.
- Plot Tags: Graphically plot all tagged variables.
- Log Tags: Numerically log all variables that have been tagged for plotting/logging.
- New Mark: Takes a 5 second average of highlighted variables and saves into an excel file
- Mark: View marks taken during 4G display session, marks are deleted unless saved.
- Recorder Settings: Change recorded settings (time, sampling rate, etc..)
- Load Recorder Settings:Loads and tags same variables for plotting/logging that are present in a plot file (.bplt).



#### **18 Key Engine Health Parameters**

- Engine Speed Reading from the crank sensor
- Manifold Pressure Pressure reading from intake manifold in psia.
- Coolant temperature Direct reading from ECT sensor on 2.5L in deg f.
- > Cylinder head temp Direct reading CHT sensor if equipped in deg f.
- > Intake air temperature Reading of the manifold intake air temperature in deg F.
- > Spark Advance Shows current timing of ECU, preset in ECU in degrees.
- Fuel rail pressure Pressure reading from gasoline fuel block in psia.
- Gaseous pressure target DEPR target output pressure to mixer in psia.
- Gaseous pressure actual DEPR actual output pressure to mixer in psia.
- VSW Switched Ignition voltage from key switch in volts.
- Closed loop1 Fueling offset lean or rich to achieve stoic with pre cat O2 sensor %.
- Adaptive1 Fueling offset lean / rich to achieve stoic with post cat O2 sensor.
- EGO1 pre catalyst O2 sensor voltage reading in volts.
- EGO2- post catalyst O2 sensor reading in volts.
- > TPS command throttle position commanded %.
- TPS position throttle position actual %.
- FPP commanded commanded foot pedal position in %.
- Fpp actual actual foot pedal position in %..



#### **Right Click to Select Parameters**

le Page Flash Comm Port Pl	ot/l.og Lettings Help				, Maria
EControls	aults MIL		onnecting to target (12) SB CAN connected at 250 kbps (SA=0)	· ·	
Fault Access	Closed-Loop Control	System States	Monitored Drivers	Diagnostic Modes	Derates / Warnings
ngine Speed 0 rpm anifold Pressure 14.44 psia arometric Pressure 14.45 psia arometric Pressure 66.4 deg 1 dinder Head Temp 66.3 deg 1 anifold Temperature 66.3 deg 1 anifold Temperature 66.3 deg 1 take Air Temperature 72.4 deg 1 bark Advance 1.7 BTD ulse width 46.8 ms rel rail pressure - Pri 15.9 psia el rail pressure - Sec 79.7 psia rel temperature 85.7 deg 1	Closed-loop 1         0.0         %           Closed-loop 2         0.0         %           Post-cat CL offset         0.000         phi           Adaptive 1         0.0         %           EG0 1         0.001         volts           EG0 2         0.000         volts           EG0 3         0.011         volts           EG0 4         0.000         volts           Attemate-Fuel trim duty-cycle         0.0         %	Hun Mode     Stopped       Power Mode     Key-off       Fuel Type     Gasoline       Fuel Supply     Off       Fuel/Spark inhibit input     Nomal       Fuel Control Mode     Open Loop       Governor switch state     None       Active governor type     Min       Active governor mode     Isochronous       Brake pedal status     Depressed       Oil pressure state     Low - Ignored	Fring Cylinder Iow-side Order Number voltage         Injector-off Iow-side voltage         Spark Coil dwell ms           1         1         0.0         0.0         2.50           2         3         0.0         0.0         2.50           3         4         0.0         0.0         2.50           4         2         0.0         0.0         2.50           5         X         0.0         0.0         2.50           6         X         0.0         0.0         2.50           7         X         0.0         0.0         2.50           8         X         0.0         0.0         2.50           9         X         0.0         0.0         2.50           10         X         0.0         0.0         2.50	Spark kill Normal  Injector kill Normal DBW test Off  External power Automatic  Cylinder numbering Firing Order SnapShot Base Definitions: fuel_type_u16 run_tmr_sec Vbat	Derate 1     J       Derate 2     J       Low Rev-Lim     J       Forced Idle     J       Shutdown     J       MIL output pin     J       Buzzer output pin     J       Hard warning output     J       Flight Data Base Definitions:     Imm       Imm     CL_BM2       rMAP     Vbat
seous pressure target         0.00         "H2C           seous pressure actual         0.00         "H2C           rent governor target         1200         rpm           gine Load         87.4         %           ment estimated torque         0.0         %           vattery         12.2         volts           witched         0.0         volts           ur meter         105.901         hours	D         TPS position         5.1         %           D         TPS1 percent         5.1         %           TPS2 percent         2.2         %           TPS1 voltage         0.794         volts           TPS2 voltage         4.170         volts           FPP command         0.0         %           FPP position         0.0         %           FPP1 voltage         0.0000         volts           FPP2 voltage         5.000         volts	Oil pressure coning     Low V = OK       IVS state     Off Idle       Input Voltages     0.4       Gov1 voltage     0.4       Oil pressure voltage     0.4       Voltage     4.9       Voltage     4.9       Voltage     4.0       Voltage     3.2       Voltage     2.6	Fault action persist mode     Cycle       Fault action persist cycles     3 cycles       Fault action persist MIL     Disabled       Fault shutdown inhibit     Disabled       Fault shutdown inhibit Aux DIG config     Default       Fault adaptive learn disable     Fuel       Download ECM Details     View/Set Fault Parameters	Ipm         IPP_pct           rMAP         TPS_pct           rECT         EGO1_volts           rIAT         EGO2_volts           CL_BM1         PW_avg           CL_BM2         TRIM_DC           A_BM1         HM_hours           Snap.Shot Custom Definitions:           EMPTY         EMPTY           EMPTY         EMPTY           EMPTY         EMPTY	PPP_oct     PW_avg       TPS_pct     A_BM1       CL_BM1     A_BM2       Flight Data Custom Definitions:     EMPTY



## Plot Up to 20 Tagged Variables

EDIS ECI Target Communications

Constructions       Chartage       Description       Description <thdescription< th="">       Description</thdescription<>	<u>File Page</u> Flash (	<u>C</u> omm Port	Plot/Lon Countys In	alb.									
Contraction       Current of the contraction of t	<b>E</b> Contr		Clear Tags	OHLE			onnecting	to target (12)	0 kbps (84=0)	<u> </u>			
Fault Access       New Barr       Out Man         Fault Access       New Barr       Out Main         Fight Speed       No       Christian       System States         Barnetic Presure       Fault S.       Number Mark (Silent)       Christian       System States       Monde Spped       Spect Armings       Diagnostic Models       Derates / Warnings         Barnetic Presure       Fault S.       Index Corder Settings.       Corder Kinner       Diagnostic Models       Spack Air III       Derates / Warnings         Gold Resource State       Fault Signe       Load Recorder Settings.       Diagnostic Models       Diagnostic Models       Derates / Warnings         Mindld Temperature       Fault Signe       Diagnostic Models       Spack Air III       Diagnostic Models       Diagnostic Mod				Ctrl+P		REC	SB CAN C	Jimecleu al 25	0 KDPS (3A=0)	<u>.</u>			
Spark Advance       0.0       BTDC       EGO 4       0.000 volts       Active governor type       Min         Pulse width       30.1 ms       Attemate-Fuel       0.0       v.       Active governor mode       Isochronous       Pier all pressure - Pi       0.00       0.00       2.50       Soft warning output       Soft warning output         Fuel rail pressure - Pri       150       psia       DBWA & FPP Variables       Data Base Definitions:       Pight Data Base Definitions:       Soft warning output       Soft warning output         Fuel rail pressure - Sec       7.5       DBWA & FPP Variables       Difference       Difference       Pick TPS postion       Soft warning output       Soft warning output         Gaseous pressure actual       0.00       "H20       TPS postion       5.1       "       Pight Data Base Definitions:       Pight Data Base Definitions:       Soft warning output       Soft warning output         Gaseous pressure actual       0.00       "H20       TPS postion       5.1       "       Pight Data Base Definitions:       Pight Data Base Definitions:       Soft warning output         Current estimated torque       0.00       "TPS postion       5.1       "       Pight Data Custom Definitions:       Pight Data Custom Definitions:       Soft warning output         Current estimated torque	Fault Access Engine Speed Manifold Pressure Barometric Pressure Coolant Temperature Cylinder Head Temp Manifold Temperature Intake Air Temperature	0 pp 14,44 pr 14,45 pr 97,8 dr 97,8 dr 97,8 dr 97,8 dr 97,8 dr	Log Tags New Mark (Silent) Marks Recorder Settings Load Recorder Setting Log EDIS Events Burst Mode Fast Plot EGO 2 EGO 3	Ctrl+L Ctrl+Shift+M ngs	System St Run Mode Power Mode Fuel Type Fuel Supply Fuel/Spark inhibit input Fuel Control Mode Governor switch state	tates Stopped Key-off Gasoline Off Normal Open Loop None	Firring Cy Order No 1 2 3 4 5	Monitore Injector-on low-side woltage 1 0.0 3 0.0 4 0.0 2 0.0 2 0.0	Injector-off low-side voltage     Spark Coil dwell ms       0.0     2.50       0.0     2.50       0.0     2.50       0.0     2.50       0.0     2.50       0.0     2.50       0.0     2.50       0.0     2.50       0.0     2.50       0.0     2.50       0.0     2.50	Diagnos Spark kill <u>Norma</u> Injector kill <u>Norma</u> DBW test External power Cylinder numberin	al V al V Off V Automatic V g Firing Order	Derates / Derate 1 Derate 2 Low Rev-Lim Forced Idle Shutdown MIL output pin Buzzer output pin Buzzer output pin	/ Warnings
Pulse width       30.1 ms       Atternate-Fuel tim duty-cycle       0.0 %       Active governor mode lisochronous       8 × 0.0 0.0 2:50       SnapShot Base Definitions:       Right Data Base Definitions:         Fuel rail pressure - Src       73.6 psia       DBWA & FPP Variables       Brake pedal status       Depressed       0.0 0.0 2:50       10 × 0.0 0.0 2:50       10 × 0.0 0.0 2:50       10 × 0.0 0.0 2:50       10 × 0.0 0.0 2:50       10 × 0.0 0.0 2:50       10 × 0.0 0.0 0.0 2:50       10 × 0.0 0.0 0.0 2:50       10 × 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0	Spark Advance	0.0 BT	TDC EGO 4	0.000 volts	Active governor type	Min	6   7	X 0.0				Soft warning o	utput
DBWA & FPP Variables       DBWA & FPP Variables       Brake pedal status       Depressed       9       X       0.0       0.0       2.50         Fuel raip ressure - Sec       79.6       psia       DBWA & FPP Variables       Brake pedal status       Depressed       9       X       0.0       0.0       2.50         Gaseous pressure target       0.00       "H20       "H20       State       Differsure state       Dury and filter         Gaseous pressure actual       0.00       "H20       "H20       State       Differsure state       Dury and filter       Fault action persist mode       Cycle       Fault action persist mode       Fuel mathematication persist mode       Cycle       Fault action persist mode       Cycle       Fault action persist mode       Fuel mathematication persist mode       Fuel mathematication	Pulse width	30.1 ms	s Alternate-Fuel trim duty-cycle	0.0 %	Active governor mode	Isochronous	8	x 0.0 x 0.0	0.0 2.50	Saaa Shat Basa D	)ofinitiono:	Eicht Data Page	
New Grand Exite	Fuel rail pressure - Sec Fuel temperature Gaseous pressure target Gaseous pressure actual Current governor target Engine Load Current estimated torque Current estimated torque V battery V switched Hour meter MIL total on-time Currulative starts	79.6         ps           85.7         de           0.00         "H           0.00         "H           1200         Pr           87.5         %           0.0         N           0.0         %           12.6         vo           105.917         ho           0.370         ho           733         sta	DBWA & FF           eg F         TPS command           120         TPS1 percent           m         TPS2 percent           TPS1 voltage         TPS1 voltage           m         TPS2 voltage           FPP command         FPP command           bits         FPP1 voltage           purs         FP2 voltage           IVS voltage         IVS voltage	P Variables           30.0         %           5.1         %           5.1         %           2.2         %           0.795         volts           4.169         volts           0.00         %           0.00         %           0.00         volts           5.000         volts           5.000         volts	Brake pedal status	Depressed       Low - Ignored       Low V = OK       Off Idle       oges       0.4       volts       0.4       volts       4.9       volts       4.0       volts       2.3       volts       2.6	9   10   Fault action Fault action Fault action Fault action Fault shutt fault	X 0.0 X 0.0 n persist mode n persist cycles n persist MIL down inhibit down inhi	0.0 2.50 0.0 2.50 Cycle 3 cycles Disabled Disabled DiG config Default Fuel CM Details It Parameters Pending Faults	fuel_type_u16           run_tmr_sec           rpm           rMAP           rECT           rIAT           CL_BM1           CL_BM2           A_BM1           SnapShot Custor           EMPTY           EMPTY           EMPTY           EMPTY           EMPTY	A_BM2           Vbat           FPP_pct           TPS_pct           EG01_volts           EG02_volts           PW_avg           TRIM_DC           HM_hours           Definitions:           EMPTY           EMPTY           EMPTY           EMPTY           EMPTY	rpm rMAP FPP_pct TPS_pct CL_BM1	CL_BM2 Vbat PW_avg A_BM1 A_BM2 m Definitions:
		700 00						View Previously	r critarily radius				



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#### **Plot/Log Engine Parameters**

EDIS ECI Target Communications

File Page Flash Comm Port Plot/Log Settings Help





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#### Save Engine Parameters to File





# Saving Dataplot File to Desktop





#### DataPlot of the Engine Parameters



#### **Clear TAGS: Removes Green Shading**

F EDIS ECI Target Comr	munications											- O
<u>F</u> ile <u>P</u> age Flash <u>C</u> o	omm Port	Log Settings He	elp									
EOssta	C	learTags				connecting to ta	rget (12)		<u> </u>			
EContro	V/S" 🔁	etTags	Ctrl+P	$\neg \neg \checkmark$	PEC	ISB CAN conne	cted at 250 kt	bps (SA=0)	_			
	<u>L</u> o	og Tags	Ctrl+L		REC				<u> </u>			
Fault Access	Ne	ew <u>M</u> ark	Ctrl+M	System S	tates		Monitored D	Drivers	Diagnos	stic Modes	Derates	s / Warnings
	N	ew Mark (Silent)	Ctrl+Shift+M	Run Mode	Stopped		Injector-on Inj	iector-off Spark Coil	Spark kill Norm	al 🔻	Derate 1	0
ingine Speed	0 npMa	arks		Power Mode	Key-off	Firing Cylinder	low-side lo	ow-side dwell ms	Injector kill Norm	al 🔻	Derate2	0
Manifold Pressure	14.45 Pf Re	ecorder Settings				Order Number	voltage v	voltage	DBW test	Off 🔻	Low Rev-Lim	1 O
larometric Pressure	14.45 P <sup>1</sup> Lo	ad Recorder Settin	igs	Fuel Type	Gasoline	1 1	0.0	0.0 2.50	External power	Automatic <b>V</b>	Forced Idle	õ
Coolant Temperature	106.0 d 🗸 L o	a EDIS Events		Fuel Supply	Off	2 3	0.0	0.0 2.50	Cylinder numberin	Eiring Order	Shutdown	O.
Cylinder Head Temp	106.0 d			Fuel/Spark inhibit input	Normal	3 4	0.0	0.0 2.50	cylinder nambenin		MIL output p	in 🖏
Manifold Temperature	106.0 d	urst Mode Fast Plot	1 1 1 1 1 1 1 1 1 1 1	Fuel Control Mode	Open Loop	4 2	0.0	0.0 2.50			Buzzer outou	t pip
ntake Air Temperature	74.5 deg F	EGO 3	0.010 volts	Governor switch state	None	5 X	0.0	0.0 2.50				
Spark Advance	0.0 BTDC	EGO A		Active governor type	Min	6 X	0.0	0.0 2.50			Hard warning	) output
Pulse width	32.6 ms	Alternate-Fuel	0.000 00.00	Active governor mode	Isochronous	7 X	0.0	0.0 2.50			Soft warning	output
Fuel rail pressure - Pri	15.2 psia	trim duty-cycle	0.0 %			8 X	0.0	0.0 2.50	SnapShot Base [	Definitions:	Flight Data Bas	e Definitions:
uel rail pressure - Sec	79.6 psia	DRWA & FP	P Variables	Brake pedal status	Depressed	9   X	0.0	0.0 2.50	fuel_type_u16	A_BM2	rpm	CL_BM2
uel temperature	86.2 deg F	TPS command	30.0 %	Oil pressure state	Low - Ignored	10   X	0.0	0.0 2.50	run_tmr_sec	Vbat	rMAP	Vbat
Gaseous pressure target	0.00 "H2O	TPS position	51 %	Oil pressure config	Low V = OK				rpm	FPP_pct	FPP_pct	PW_avg
Gaseous pressure actual	0.00 "H2O	The	5.1 %	IVS state	Off Idle	Fault action per	sist mode	Cycle 🔻	rMAP	TPS_pct	TPS_pct	A_BM1
urrent governor target	1200 mm	1PS1 percent	5.1 %	1		Fault action per	sist cycles	3 cycles	rECT	EGO1_volts	JCL_BM1	A_BM2
Engine Load	875 %	TPS2 percent	2.2 %	Input Volte	ages	Fault action per	sist MIL	Disabled 🔻	CL PM1	EGO2_volts		
Current estimated torque	0.0 Nm	TPS1 voltage	0.794 volts	Gov1 voltage	0.4 volts	S Fault ebutdown	inhihit 🖉					
Current estimated torque	0.0 %	TPS2 voltage	4.169 volts	Gov2 voltage	0.4 volts	S Epult shutdown	inhihit Aux DIG	oonfin Default	A BM1	HM hours		
Current estimated torque	10.0 %	FPP command	0.0 %	Oil pressure voltage	4.9 volts	S Fault adaptive l	innibil Aux DiG		Span Shot Custon	n Definitions:	Flight Data Cue	tom Definitions:
/ battery	12.5 volts	FPP position	0.0 %	MAP voltage	4.0 volts	s aut adaptive i		ruei	EMPTY	EMPTY	EMPTY	EMPTY
/ switched	0.0 volts	FPP1 voltage	0.000 volts	ECT/CHT voltage	2.1 volts	3	Download ECM	Details	EMPTY	EMPTY	, person e e	Tean Li
Hourmeter	105.928 hours	FPP2 voltage	5.000 volts	IAT voltage	2.5 volts	s Via	w/Set Fault Pa	rameters	EMPTY	EMPTY		
MIL total on-time	0.370 hours	IVS voltage	5.000 volts		,	Vit	and bet rout ro	andirectora	EMPTY	EMPTY		
Cumulative starts	734 starts		,			View	Previously Pen	nding Faults				
							Man Classed	Care dan				
							view Cleared H	rauits				



#### Load Recorder Settings

EDIS ECI Target Com	nmunications													
<u>File Page Flash (</u>	Comm Port Plot	Log Settings H	elp											
		lear Tags				onnecti	ng to ta	rget (12)			<u>.</u>			
Econtro	o/s ⊨ ₽	lot Tags	CtrI+P			ISB CAN	conne	cted at 250	kbps (SA=	=0)				
		og Tags	Ctrl+L		REC									
Fault Access	Ne	ew <u>M</u> ark	Ctrl+M	System S	tates		1	Monitored	Drivers		Diagnos	stic Modes	Derates	/ Warnings
		ew Mark (Slient)	Ctri+Snint+M	Run Mode	Stopped			Injector-on	Injector-off	Spark Coil	Spark kill Norm	al 🔻	Derate 1	)
Engine Speed	0 m Ma	arks		Power Mode	Key-off	Firing	Cylinder	low-side	low-side	dwell ms	Injector kill Norm	al 🔻	Derate2	)
Manifold Pressure	14.45 PI	corder Settings			Caralian	order	Number	voitage	voitage	0.50	DBW test	Off 🔻	Low Rev-Lim	)
Barometric Pressure	14. 0 Pt Lo	oad Recorder Settin	ngs		Gasoline	1		0.0	0.0	2.50	External power	Automatic	Forced Idle	)
Coolant Temperature	104.2 d VL0	OG EDIO Evento				2	3	0.0	0.0	2.50	Cylinder numberin	Firing Order	Shutdown	0
Cylinder Head Temp	104.2 d	uret Mada East Plat		Fuel/Spark inhibit input	Normal	3	4	0.0	0.0	2.50	-		MIL output pir	n Ö
Manifold Temperature	104.2 d		0.001 VOILS	Fuel Control Mode	Open Loop	4	2	0.0	0.0	2.50			Buzzer output	pin )
Intake Air Temperature	74.5 deg F	EGO 3	0.010 volts	Governor switch state	None	5	X	0.0	0.0	2.50			Hard warning	output
Spark Advance	0.0 BTDC	EGO 4	0.000 volts	Active governor type	Min	6	X	0.0	0.0	2.50			Soft warning	output
Pulse width	33.2 ms	Alternate-Fuel	0.0 %	Active governor mode	Isochronous	7	X	0.0	0.0	2.50			Solt warning	Jolput 🚽
Fuel rail pressure - Pri	15.3 psia	trim duty-cycle	1 0.0 *			8	X	0.0	0.0	2.50	SnapShot Base	Definitions:	Flight Data Base	Definitions:
Fuel rail pressure - Sec	79.6 psia	DBWA & FF	P Variables	Brake pedal status	Depressed	9	X	0.0	0.0	2.50	fuel_type_u16	A_BM2	rpm	CL_BM2
Fuel temperature	86.2 deg F	TPS command	30.0 %	Oil pressure state	Low - Ignored	10	X	0.0	0.0	2.50	run_tmr_sec	Vbat	rMAP	Vbat
Gaseous pressure target	0.00 "H2O	TPS position	51 %	Oil pressure config	Low V = OK						rpm	FPP_pct	FPP_pct	PW_avg
Gaseous pressure actual	0.00 "H2O	TDC1	5.1 %	IVS state	Off Idle	Fault ad	ction per	sist mode		Cycle 🔻	rMAP	TPS_pct	TPS_pct	A_BM1
Current governor target	1200 mm	TPSTpercent	5.1 *	lage the last		Fault ad	ction per	sist cycles	1	3 cycles	rEC T	EGO1_volts	CL_BM1	A_BM2
Engine Load	87.5 %	TPS2 percent	2.2 %	Input voite	ages	Fault ad	ction per	sist MIL	Di	sabled 🔻	CL BM1	PW avo		
Current estimated torque	0.0 N-m	IPS1 voltage	0.794 volts	Gov1 voltage	0.4 volts	Fault sh	utdown	inhibit		isabled 🔻	CL BM2	TRIM DC		
Current estimated torque	0.0 %	TPS2 voltage	4.169 volts	Gov2 voltage	0.4 volts	Fault sh	utdown	inhibit Aux D	IG config	Default V	A_BM1	HM_hours		
Whatten:	125	FPP command	0.0 %	Oil pressure voltage	4.9 volts	Fault a	tantive l	eam disable		Fuel	Snap Shot Custon	n Definitions:	Flight Data Cust	om Definitions:
V ballery	12.5 Volts	FPP position	0.0 %	MAP voltage	4.0 volts	3 C	apaven	can alsobic	1		EMPTY	EMPTY	EMPTY	EMPTY
v switched	U.U Volts	FPP1 voltage	0.000 volts	ECT/CHT voltage	2.1 volts		(	Download EC	CM Details		EMPTY	EMPTY		
Hour meter	105.928 hours	FPP2 voltage	5.000 volts	IAT voltage	2.5 volts	3	Vie	w/Set Fault	Parameters		EMPTY	EMPTY		
MIL total on-time	0.370 hours	IVS voltage	5.000 volts			4					EMPTY	EMPTY		
Cumulative starts	734 starts						View	Previously F	ending Faul	ts				
						Г		View Cleare	d Faults					
						4		non ordere						



#### Load Recorder Settings

E Select Plot/Log Data F	ile	$\times$
$\leftarrow \rightarrow $ $\checkmark $ $\uparrow$	🔄 > This > Desktop 🛛 🗸 🔿	Search Desktop
Organize 👻 New fo	older	≣ ▾ 🔟 😮
🖌 🔲 This PC	Name	1
> Desktop	🖉 rayco test data plot file 11-6-2024	
>  Documents		kwe
> 🛓 Downloads		
> 🕖 Music	1	Highlight File & Load
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> 🚺 Videos		
> 🔚 Local Disk (C:)	 	
Fil	e name: rayco test data plot file 11-6-2024	
		Load Cancel

# PAGES

#### PAGE Menu





# MAIN Page

#### Main Function:

 Initial screen shown at start-up. Presents visual indication of most viewed information.

#### Secondary Functions:

- Displays ECI and customer configuration information including the 4G part numbers, displays the customer's emissions calibration MOT filename, and displays governor calibration information
- Displays system states based on current operating conditions



#### **MAIN Page**

EDIS ECI Target Communications

File Page Flash Comm Port Plot/Log Settings Help



# **FAULTS** Page

### **Faults Page**

- Main Function:
  - Displays information generally used during fault detection and provides fault code interpretation in English.
  - Historic and active faults are displayed here
  - Provides some variables to aid in diagnosing faults
  - Can clear the faults from this page as well



#### Finding Historic & Active FAULTS

<u>File Page Flash Comm Port Plot/Log Settings Help</u>							
Econtrols Faults		onnecting to target (12) SB CAN connected at 250 kbps (SA=0)	•				
Fault Access Closed-Loop Control	System States	Monitored Drivers	Diagnostic Modes	Derates / Warnings			
Engine Speed         0         rpm         Closed-loop 1         0.0         %           Manifold Pressure         14.54         psia         Post-cat CL offset         0.000         phi           Barometric Pressure         14.52         psia         Post-cat CL offset         0.000         phi           Coolant Temperature         64.5         deg F         Adaptive 1         0.0         %           Cylinder Head Temp         64.5         deg F         EGO 1         0.010         volt           Intake Air Temperature         70.7         deg F         EGO 3         0.012         volt           Pulse width         49.2         ms         Atternate-Fuel         0.0         %	Run Mode     Stopped       Power Mode     Key-off       Fuel Type     Gasoline       Fuel Supply     Off       Fuel/Spark inhibit input     Normal       Fuel Control Mode     Open Loop       Governor switch state     None       Active governor type     Min       Active governor mode     Isochronous	Injector-on Order         Injector-on low-side voltage         Injector-off low-side voltage         Spark Coil dwell ms           1         1         0.0         0.0         2.50           2         3         0.0         0.0         2.50           3         4         0.0         0.0         2.50           4         2         0.0         0.0         2.50           5         X         0.0         0.0         2.50           6         X         0.0         0.0         2.50           7         X         0.0         0.0         2.50           8         X         0.0         0.0         2.50	Spark kill Normal	Derate 1			
Fuel rail pressure - Pn     16.0 psia       Fuel rail pressure - Sec     79.7 psia       Fuel temperature     84.0 deg F       TPS command     30.0 %	Brake pedal status Depressed Oil pressure state Low - Ignored	9 X 0.0 0.0 2.50 10 X 0.0 0.0 2.50	SnapShot Base Definitions:           fuel_type_u16         A_BM2           run_tmr_sec         Vbat	rpm CL_BM2 rMAP Vbat			
Gaseous pressure target 0.00 "H20 TPS position 5.1 % Gaseous pressure actual 0.00 "H20 TPS1 percent 5.1 %	IVS state Off Idle	Fault action persist mode Cycle  Fault action persist cycles  Cycle	rMAP TPS_pct rECT EG01_volts	FPP_pct         PW_avg           TPS_pct         A_BM1           CL_BM1         A_BM2			
Current governor target         1200         Ipin         TPS2 percent         2.2         %           Engine Load         88.0         %         TPS1 voltage         0.793         volt           Current estimated torque         0.0         N-m         TPS2 voltage         4.170         volt	Input Voltages           s         Gov1 voltage         0.4         voltage           s         Gov2 voltage         0.4         voltage	Fault action persist MIL Disabled  Fault shutdown inhibit Disabled Fault shutdown inhibit Aux DIG config	rIAT         EGO2_volts           CL_BM1         PW_avg           CL_BM2         TRIM_DC           A BM1         HM hours				
Vbattery         12.2         volts         FPP command         0.0         %           Voltery         12.2         volts         FPP position         0.0         %           Voltered         0.0         %         FPP position         0.0         %	Oil pressure voltage         4.9         volt           MAP voltage         4.0         volt           B         ECT/CHT voltage         3.3         volt	Fault adaptive learn disable Fuel Download ECM Details	SnapShot Custom Definitions: EMPTY EMPTY EMPTY EMPTY	Flight Data Custom Definitions:			
Hour meter         105.901         hours         P2 voltage         5.000         volt           MIL total on-time         0.370         hours         voltage         5.000         volt           Cumulative starts         732         starts         voltage         5.000         volt	IAT voltage 2.6 volt	View/Set Fault Parameters View Previously Pending Faults	EMPTY EMPTY EMPTY EMPTY				

#### Hours, Starts & MIL Light

#### **FAULT Identification**



FAULTS are historic or active and can be viewed with engine running, idle or off



# Analyzing a FAULT

- Two sets of data are recorded for every FAULT
  - Fault snapshot and Flight data recorder
    - All the variables recorded for each can be seen on the bottom right of the faults page
    - Double click red light next to fault code





#### Viewing a Fault

#### After double clicking this page comes up

 Can clear the fault or view the Snap Shot Data or the Flight Data Recorder
 This Fault Description pops up.

urrent estimated torque     0.0     %       battery     12.2     volts       switched     0.0     volts       lour meter     105.901     hours       IIL total on-time     0.370     hours       umulative starts     732     starts	FPP command     0/       FPP position     .0       FPP1 voltage     7000       FPP2 voltage     5.000       IVS voltage     5.000	% vol vol vol	Filstoric Fault Information Fault Description: DTC 172: Adaptive-learn gasoline bank1 low J1939 SPN = 4237, FMI = 1	
Historic Fa	aults ank1 low FAULT		View Snap Shot Data View Elight Data Recorder Data Clear This Fault Clear All Faults	Fault occurred during current key cycle     Fault caused current engine shutdown     Starts since fault was active:     G

#### **View Snap Shot Data**

#### 툳 Snap Shot Data

DTC 172: Adaptive-learn gasoline bank1 low Base Variables: Custom Variables: fuel\_type\_ul6: Gasoline 238 run tmr sec: rpm: 1195 rMAP: 4.40 rECT: 187.91 rIAT: 73.06 CL BM1: -2.164CL BM2: 0.000 A BM1: -14.050A BM2: 0.000 Vbat: 14.25 FPP pct: 0.000 TPS pct: 6.245 EGO1 volts: 0.7405 EGO2 volts: 0.0938 PW\_avg: 2.40 TRIM DC: 0.000 HM hours: 102

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#### Occurrence Data:

Occurrence count:	4
Initial occurrence:	102.984 eng hours
Last occurrence:	104.532 eng hours
Went previously active:	105.3 eng hours

Close	
	· .

Download	%	
1		

Save...

# View Flight Data Recorder Data

 $\times$ 

E Flight Recorder Data for fault DTC 172: Adaptive-learn gasoline bank1 low

<u>S</u> ave Qose		mm 🗸		<b>▼</b>   M	Minimum Y Value 🛔		N	Ainimum time	-8.00	cursor time -8.00	
				Ma	aximum Y Value	\$6000.0	0 M	laximum time	2.00	cursor Y	1208.00
rpm			rMAP		FPP_pct		TPS_pct		CL_BM1	CL_B	M2
Vbat			PW_avg		A_BM1		A_BM2				
шđ	6000-										
	4800-										
	3600-										
	2400-										
	1200 -										
	0- -8.0	000	-6.0	000	-	4.000	time (s)	-2.000	)	0.000	2.000

# **Clearing the FAULT**



Double Click on the Fault to Clear.
### Clearing the FAULT.

E Historic Fault Information

#### Fault Description:



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### Gathering ECM Details

### Saving the ECM Detail Report

- History Report on all DTC Posted with Duration.
- 4G ECMs REF F and greater.
- Engine Run History with coolant temperatures above 205F in run hrs.
- Engine Run History by Loading (MAP pressure) and rpm and run hrs.
- Microsoft .XLS format for off line analysis.

#### Down load the ECM Details. Only Available on REV F or Higher ECMs.

File Page Flash Comm Port Plot/Log Settings Help

EControls -	Faults Connected MIL		Connecting to target (12) USB CAN connected at 250 kbps (SA=0)	•	
Fault Access	Closed-Loop Control	System States	Monitored Drivers	Diagnostic Modes	Derates / Warnings
Engine Speed       0       rpm         Manifold Pressure       14.46       psia         Barometric Pressure       14.45       psia         Coolant Temperature       66.1       deg         Cylinder Head Temp       66.1       deg         Manifold Temperature       66.1       deg         Intake Air Temperature       70.6       deg         Spark Advance       1.7       BTC         Pulse width       47.0       ms         Fuel rail pressure - Pri       15.9       psia         Fuel rail pressure - Sec       79.7       psia         Gaseous pressure target       0.00       "H2         Gaseous pressure actual       0.00       "H2         Current governor target       1200       mm         Engine Load       87.6       %         Current estimated torque       0.0       %         V battery       12.2       volt         Volttery       12.2       volt         Hour meter       105.901       hou         MIL total on-time       0.370       hou	Closed-loop 1         0.0         %           Closed-loop 2         0.0         %           Post-cat CL offset         0.000         phi           Adaptive 1         0.0         %           F         Adaptive 2         0.0         %           F         EGO 1         0.000         volts           F         EGO 2         0.000         volts           F         EGO 3         0.011         volts           Atemate-Fuel         0.0         %           DBWA & FPP Variables         %           F         TPS command         30.0         %           O         TPS position         5.1         %           O         TPS procent         5.1         %           TPS2 percent         2.2         %         TPS1 voltage         0.793           TPS2 voltage         4.170         volts         %         %           FPP command         0.0         %         %         %           S         FPP cottage         5.000         volts         %	Run Mode     Stopped       Power Mode     Standby       Fuel Type     Gasoline       Fuel Supply     Off       Fuel/Spark inhibit input     Normal       Fuel Control Mode     Open Loop       Governor switch state     Gov3       Active governor type     Min       Active governor mode     Isochronous       Brake pedal status     Depressed       Oil pressure state     Low - Ignored       Oil pressure config     Low V = OK       IVS state     Off Idle       Input Voltages     0.4 volt       Gov2 voltage     0.4 volt       Oil pressure voltage     4.9 volt       IAP voltage     4.0       IAP voltage     3.2       IAT voltage     2.6 volt	Injector-on Order Number         Injector-off low-side voltage         Spark Coil dwell ms voltage           1         1         0.0         0.0         2.50           2         3         0.0         0.0         2.50           3         4         0.0         0.0         2.50           4         2         0.0         0.0         2.50           5         X         0.0         0.0         2.50           6         X         0.0         0.0         2.50           6         X         0.0         0.0         2.50           6         X         0.0         0.0         2.50           7         X         0.0         0.0         2.50           8         X         0.0         0.0         2.50           9         X         0.0         0.0         2.50           10         X         0.0         0.0         2.50           9         X         0.0         0.0         2.50           9         X         0.0         0.0         2.50           10         X         0.0         0.0         2.50           5         Fault action persist mole	Spark kill       Normal         Injector kill       Normal         DBW test       Off         DBW test       Off         External power       Automatic         Cylinder numbering       Firing Order         SnapShot Base Definitions:       Firing Order         fuel_type_u16       A_BM2         run_tmr_sec       Voat         rpm       FPP_pct         rMAP       TPS_pct         rECT       EGO1_volts         CL_BM1       PW_avg         CL_BM2       TRIM_DC         A_BM1       HM_hours         SnapShot Custom Definitions:       NPTY         EMPTY       EMPTY         EMPTY       EMPTY         EMPTY       EMPTY	Derate 1       J         Derate 2       J         Low Rev-Lim       J         Forced Idle       J         Shutdown       J         Buzzer output pin       H         Buzzer output pin       J         Hard warning output       J         Soft warning output       J         Flight Data Base Definitions:       Image: CL_BM2         rMAP       Voat         FPP_pct       PW_avg         TPS_pct       A_BM1         CL_BM1       A_BM2         Flight Data Custom Definitions:       Image: CL_BM2         Flight Data Custom Definitions:       Image: CL_BM2         Flight Data Custom Definitions:       Image: CL_BM2
			View Cleared Faults		

#### Save the ECM Detail File.

E Select Output File	×
$\leftarrow$ $\rightarrow$ $\checkmark$ $\uparrow$ $\blacksquare$ $\rightarrow$ This $\rightarrow$ Desktop $\checkmark$ $\bigcirc$ $\bigcirc$ Search Desktop	
Organize 🔹 New folder 🛛 🗮 🔹	3
<ul> <li>↓ This PC</li> <li>▶ Desktop</li> <li>▶ Documents</li> <li>↓ Downloads</li> <li>↓ Music</li> </ul>	
> Z Pictures	
File name: E2452304G_037517_20241105_113914_fault_data_download ECM Details Rayco Save as type:	~
∧ Hide Folders Save Cano	k Save Button

#### ECM Detail: Speed Load History

А	D	C	U	L	1	0	11	
Speed/Loa	d Histogra	ım						
		Manifold I	Pressure					
		4	6	8	10	12	14	
Engine Spe	600	0.021764	0.079306	0.040208	0.001889	0.000611	0.041764	
	1200	30.19804	3.485069	0.060972	0.020653	0.022472	0.060097	
	2000	7.617153	9.576361	1.474014	0.691236	0.360472	2.445431	
	3000	1.344889	23.07128	10.27485	5.331167	3.671431	5.380514	
	4000	0.007111	0.249347	0.310389	0.128111	0.011319	0	
	5000	0	0	0	0	0	0	

### **RAW VOLTS Page**

### RawVolts Page

#### Function:

 Displays raw voltage feedback from 4G inputs and outputs.

#### Why Display.

 Trouble shooting sensor wiring to turn off and on and watch signal voltage change.



#### **RawVolts Page on EDIS**

#### EDIS ECI larget Communications

File Page Flash Comm Port Plot/Log Settings Help



#### Key RawVolts Page Parameters

- Aux\_DIG1 volts Fuel select; 12 volts, gnd, open
- Aux\_DIG3 volts Brake input if used
- TPS1\_Raw volts Throttle position sensor 1 voltage
- TPS2\_Raw volts Throttle position sensor 2 voltage
- FPP1(2)\_raw Foot pedal (1 & 2) input voltage
- Gov1\_raw Governor 1 input; 12 volts (engage), 0 volts (ground) or 2 volts (open)
- Gov2/DIG4\_raw Governor 2 input; 12 volts (engage), 0 volts (ground) or 2 volts (open)
- Oil pressure voltage Reference voltage; 5 volts = open, 0 volts = ok
- MAP\_raw Sensor is 0 volts if open, 0–5 volts when operating
- ECT\_raw ECT/CHT Sensor is 5 volts if open, 0 -5 volts when operating
- IAT\_raw Sensor is 5 volts if open, 0 5 volts when operating
- Aux\_PWM3 Gasoline fuel pump ground control
- Aux\_PU1 Gasoline fuel block temperature voltage
- Aux\_PD2 Gasoline fuel block pressure voltage

#### What You Learned this Afternoon.

- COMPLETED: Find Engine Specific Calibration Name, Revision and Fuel Type on MAIN page.
- COMPLETED: Find Engine Specific DTC's on Fault Page & Clear Faults on FAULT Page.
- COMPLETED: Download Engine ECM Details File from FAULT Page.
- COMPLETED: Reprogram 4G ECUs using .mot files from FILE Pull Down.
- COMPLETED: Dataplot required engine health parameters from PLOT/LOG Pull Down.

COMPLETED: Learn the steps and tools in tele-engine support.



#### **Common Issues**

- Diesel/Contaminated gasoline introduced in the fuel system
  - Clean lines/fuel rail, replace injectors, block filter and pump
- Low power on a natural gas Genset
  - Typically, not enough fuel pressure to the engine
- No start, no codes present
  - Typically fuel related issue
- High gasoline fuel pressure; code 1561
  - Bad fuel block or fuel pump is grounded directly (must be PWM controlled)
- O2 sensor failure; code 134 or 154
  - Improper mounting from installation
  - Liquid being introduced into the exhaust stream.
- Bricked 4G (Bootstrap Mode)
  - User lost power or unplugged the COMs cable while programing

#### Important Service Documents to Locate

- Remember All Documents Available at editecinfo.com.
  - Engine Wiring Schematics
  - Customer Interface Wiring Schematics
  - Latest 4G-GCP Diagnostic Manual
  - Service Manuals
  - Parts Manuals
  - Warranty Information

# Thank you for your time and attention and the partnership we share together in Emissions Management

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### **Appendix of Additional Topics**

- Identify Engine System Components.
- Stochiometric Fuel Control Mechanics.
- MSG-425 Engine Timing.
- Predictive Maintenance.
- Telematics.
- Propane Backfire and Detonations.

#### Identify Engine System Components

- Identify the 4 components of the propane fuel system and find their location.
- Identify the 5 components of the gasoline fuel system and find their location.
- Identify all of the engine input sensors.
- How many are there? Identify their locations?
- Identify all of the engine output actuators.
- How many are there? Identify their locations?

#### Stoichiometric Fuel Control System for Emissions Management

- Spark and injectors timing and duration of ECM control.
- Pre catalyst O2 sensor
- Closed loop1
- Adaptive1
- Catalyst
- Post catalyst O2 sensor.
- System Component Identification.
- Explain how the system works.

#### Pages, Service 1



#### Pages, Service 2



### MSG425 Engine Timing

- Tools required.
  - M6 bolt 80 mm shcs.
  - Crankshaft pin
  - Camshaft bar.
  - New Crankshaft bolt.
- Remove intake manifold.
- Remove valve cover.
- Thread crankshaft pin into engine block
- Register crankshaft on pin for tdc.
- Does cam shaft bar slide in yes/no.
- No rotate crankshaft 360 again and recheck.
- Yes Cam and crank line up
- Thread in M6 bolt through the crankshaft pulley into the timing cover.
  - **Tighten crank bolt to torque specified.**

#### Predictive Maintenance 1 of 2.

#### EDItechinfo.com

#### Operators Manual pgs 23–30

Hours Running Or Miles Driven Maintenance Operation	Daily	After 1st 50 hrs. (2500 km or 1500 miles)	Every 100 hrs. (5000 km or 3000 miles)	Every 200 hrs. (10,000 km or 5000 miles)	Every 400 hrs. (20,000km or 12,000 miles)	Every 800 hrs. (40,000 km or 24,000 miles)	Every 4 years max.
Check engine oil level and top up if necessary	x	х					
Check engine coolant level and top up if necessary with correct mixture	x	х					
Check visually for oil, fuel or coolant leaks	x						
Check all instruments, controls and warning lights. Check hot and cold start functions	х						
Check coolant, oil, fuel, exhaust and vacuum hoses/pipes for leaks, damage, deterioration and correct routing. Check all visible electrical wiring for security, correct routing and evidence of chafing or heat damage.		x	x	х	x	x	
Change engine oil and renew oil filter					Х	Х	



#### Predictive Maintenance 2 of 2.

Hours Running Or Miles Driven	Daily	After 1st 50 hrs. (2500 km or 1500 miles)	Every 100 hrs. (5000 km or 3000 miles)	Every 200 hrs. (10,000 km or 5000 miles)	Every 400 hrs. (20,000km or 12,000 miles)	Every 800 hrs. (40,000 km or 24,000 miles)	Every 4 years max.
Check belt condition and replace if necessary				х	х	х	
Check fuel filter element and renew as necessary				х	х	х	
Renew air cleaner element					Х	Х	
Spark plugs clean and inspect (Replace every 3,000 hours)						х	
Check all nuts & bolts for tightness					Х	Х	
Inspect PCV Valve					Х	Х	
Clean coolant filler cap and renew cap if seal has deteriorated							x
Lubricate PTO bearings if equiped			Х	Х	Х	Х	



#### **Telematics & Remote Control**

- Automatic and Manual Mode.
- Manual Arm for Automatic Mode for Remote Start
  - Remote start triggered from OEM on 42 pin ford customer interface connector pin 1 for VSW ON and pin 15 for START.
  - Can Uses Auto Start Function to pulse Pin 7 or pin 10.
  - OEM monitors rpm and stops crank after 450 rpm.
  - OEM monitors condition to remove VSW & stop engine.
- Yellow MIL and Green OPERATE lights viewable from the pickup truck from the road and the field.
- Telematics
  - Supports satellite, cellular and wifi interfaces.
  - CAN based interface with dongle tee off.
  - Monthly & Yearly Subscriptions.
  - First Year Provided by OEM.
  - Y-dongle cable available from EDI.



#### Root Cause Analysis: Detonations & Backfires on Stage 5 LP PG Engines.



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#### **Propane Backfire & Detonations**

- Backfires are defined as explosions of propane gas in the intake manifold during starting rpm from 150-300 rpm. Very Violent and can damage the Aluminum manifold. Eliminated March 2023 with over 1500 wsg873 LP shipped. Backfire 9 calibration.
- Detonations are defined as explosions of propane gas in the intake manifold during the starting flare from 300 to 1800 rpm. Engine usually run through the detonation and operates normally. DEC 2024 eliminated in Backfire 12 calibration



#### Current Testing Success of qty (3) Stage 5 Gensets on the Backfire12 calibration.

- UEW 00360 was start tested over 50+ starts on backfire12 calibration without detonation or backfire.
- UEW 00359 was start tested over 70+ starts on backfire12 calibration without detonation or backfire.
- UEW 00346 was start tested over 50+ starts on backfire 12 calibration without detonation or backfire.
- G2 transient genset performance specification has been rerun at 63.5 kWe to reverify previous results.

#### **Root Cause of Detonations**

- Root Cause of Detonations: The air fuel mixture is lean when the min gov takes over from the crank mode during starting and the throttle response is large to catch up to 1500 rpm. The DEPR cannot support stoichiometric fuel burn causing the lean fuel mixture to burn slowly and in the exhaust manifold. The flame then propagates through the piston top to the intake manifold causing the unburned fuel to ignite with a detonation.
- Moving the handoff rpm from the crank mode to the min gov control from 500 rpm to 900 rpm makes the hard throttle response less significant to the volume of air required at 900 rpm and eliminates the chances for a lean burn detonation.
- We were unable to clamp the min gov throttle response because of the G2 genset transient response required.



# Difference Between Detonations & Backfires

- Starting Backfires occur during crank rpm of 160 to 250 rpm with an errant spark that lights the propane gas in the intake air system. There were never any backfires reported.
- Running Detonations occur after starting and before reaching 1500 rpm during the hand off from the crank mode to the min gov (governor) and are caused by a lean propane mixture that burns in the exhaust manifold and crosses over to the intake manifold.
- Detonation are less violent than backfires and cause less damage to intake air system.
- Because of the work that went into meeting Stage 5, G2 genset performance specifications, changes to the min gov gains were not allowed to restrict the throttle max movement to 38%.
- Because of the Stage 5 catalyst heating cycle requirement to meet emissions, spark retard of -7 degrees was also required at the handoff from crank mode to min gov.

#### **Calibration Development History**

- Backfire9 used as the baseline starting point for Stage 5 Himoinsa starting calibration development. Was developed and tested on over 600 WSG873 LP engines in early 2023, 2 years ago without a backfire or detonation since backfire9 was implemented.
- Backfire10 fixed a problem in the delivered calibration reducing the spark retard during warmup for catalyst activation from -15 deg to -7 deg.
- Backfire11 moved the handoff rpm up from crank mode to min gov from 500 to 700 rpm.
- Backfire12 moved the handoff rpm up from crank mode to min gov from 700 to 900 rpm.

#### 2 detonations on one start on backfire11 calibration with engine UEW00360







#### Backfire12 Starting Statistics

- Cam Crank Synch 0.817 sec.
- Fuel Clear Actual 0.481 sec.
- Fuel Clear Cycle 2.969 sec.
- Fuel On Stability 0.735 sec.
- Total Crank Time 5.748 sec.
- Transition from Crank Mode 932 rpm.
  - Max RPM 1700 rpm.
  - Total Start Time to 1800 rpm 16.481 sec.
  - Catalyst Heating Cycle 10.024 sec.



# Thank you for your time and attention and the partnership we share together in Emissions Management

Jerry kosner 12 DEC 2024

