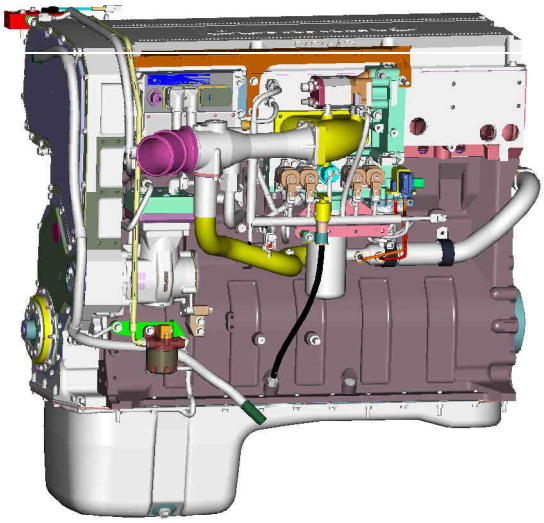
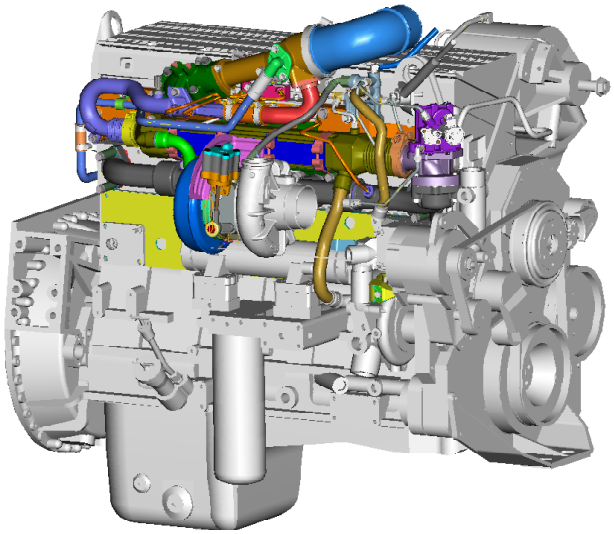
CM870 COMMON APPROACH TO CONTROL SYSTEM DIAGNOSTICS

ENFORCER '02





ISM '02

Brian J. Ouellette
HDD Controls Systems Integration

Phase 5.4 Software

CM870 COMMON APPROACH TO CONTROL SYSTEM DIAGNOSTICS

CM870 Common Approach To Control System Diagnostics.doc
Full Production Version
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Revision Number 06 Brian J. Ouellette

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Overview: This document is intended to support on-site troubleshooting and diagnostics of customer complaints for **2002 Heavy-Duty engine platforms** with the **CM870 Controls System**. This document can be used along with NGET or CalTerm for investigation, troubleshooting, and diagnosis of engine performance and electronic controls related issues.

Purpose: The information contained in this document is based in part on documented tests and procedures best suited to support in-field efforts for Cummins CM870 heavy-duty engine platforms. Much of this information comes from legacy procedures contained in the document "***Common Approach To Diagnostics Using Calterm***" authored by Wayne Eberhard and Richard Croft. Because the CM870 control system uses a new naming convention for engineering parameters, I have converted legacy information over to the new naming convention. In addition, the CM870 control system includes new control strategies for Air Handling and emissions to meet the 2002 requirements. Information on troubleshooting and diagnostics for these systems is included here. My intent for this document is to provide information and support to those in the field as well as those based in Cummins engineering facilities. With tools like NGET and CalTerm, documentation of data within this document will provide more detailed definition of engine conditions associated with specific issues. This information, along with driver comments and concerns, will help in achieving a better responsiveness to customer needs and allow us to develop products which meet or exceed customer expectations.
Brian J. Ouellette

DOCUMENT CONTENTS:

- **Data Logging Using Available Engineering Tools (Calterm and NGET)**
- **Troubleshooting And Diagnostics Parameter Guide**
- **CM870 Engineering States**
- **CM870 Fault Code List**
- **CM870 Control System Diagrams**
- **Customer / Driver Survey**

THIS DOCUMENT SUPPORTS THE FOLLOWING SOFTWARE VERSION:

HD02	**Full Production ENFORCER '02**	**PHASE 5.4.3.0x SOFTWARE**	**PV CM870**
HD02	**BETA ISM '02**	**PHASE 5.4.3.0x SOFTWARE**	**PV CM870**

Brian J. Ouellette
HD Controls Systems Integration
(812) 377-7046 / pgr #888-966-7313
b.j.ouellette@cummins.com

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DATALOGGING USING AVAILABLE ENGINEERING TOOLS (CALTERM and NGET)

EXTERNAL/MONITOR DATA LOGGING

External (MONITOR) Data Logger Helpful Hints:

When to use:	For data acquisition that does not require high speed collection Collection of Duty Cycle or Vehicle Mission data Macro-view of events or problems Normal event datalogging while monitoring Calterm or NGET monitor screen For capturing Fault Codes as well as data
Length of datalog:	Datalog length from 0.1 to 3600 seconds
File size:	20 minute datalog of 16 parameters approximately 760 kbytes
Advantages of Monitor Data Logger:	Monitor data while logging Time based datalogs beyond a few minutes Able to collect data during extended trips Does not require an unsecured ECM Ability to datalog fault codes
Disadvantages of Monitor Data Logger:	Limited to 16 parameters in Calterm Cannot capture high speed events (requires IDL) Time based data collection only

INSTRUCTION FOR USING THE EXTERNAL (MONITOR) DATA LOGGER

CALTERM INSTRUCTIONS:

1. Set-up Monitor Screen with parameters to data log. Use CM870 Common Approach to Diagnostics to determine which parameters to datalog.
2. In the Monitor Screen, hit the ALT-L keys to bring up the Monitor Log Menu.
3. Select MANUAL LOG by moving down to MANUAL LOG and hitting the Enter key. A Check mark should be next to MANUAL LOG.
4. Select the INTERVAL TIME by moving down to INTERVAL TIME and hitting Enter.
5. For INTERVAL TIME, enter the time in which data will be collected, anywhere from 0.1 seconds to 3600 seconds.
6. DESTINATION should read DISK. If not, select DESTINATION and press the Enter key. Select DISK and press the Enter key.
7. Enter the LOG FILE NAME. Select LOG FILE NAME and press the Enter key. Manually type in the name of the datalog file you wish to save.
8. Datalog files are saved to the location shown in the UTILITY-EDIT CONFIGURATION screen next to DATA PATH. The default location is the Calterm root directory.
9. You may select to Overwrite the datalog file with a new file if OVERWRITE LOG FILE is Yes. It is suggested to keep OVERWRITE LOG FILE be set to No. This requires the user to enter a new datalog file name [7.] ever time Monitor Data Logger is invoked.
10. Select whether to log Fault Codes. Select LOG FAULTS and press the Enter key. Select ALL faults logged, ACTIVE faults logged, or NONE and press the Enter key.
11. Choose Exit to Start the Monitor Data Logger.
12. To STOP Monitor Data Logger, press the ALT-L keys.
13. To PLOT the data logged within Calterm, press the ALT-L keys to enter the Monitor Log Screen. Select PLOT and press the Enter key. Choose the file you wish to plot and press the Enter key.

INTERNAL DATA LOGGING

Internal Data Logger Helpful Hints:

When to use IDL:

For high speed data acquisition or short duration events
Cranking, stumble, hiccups, idle or PTO quality, transient events
Snap throttle, quick accel,
When you need a microscope to view the problem (not a macro-view)
When you aren't sure when the event will occur (center buffer)
When you have individual events which allow time to extract the data from ECM

Length of IDL log:

Data buffer fills at rate which is function of number of parameters and rate at which data is collected, and also whether the parameter is a byte or a word (2-bytes)

	APPROXIMATE TIME TO FILL BUFFER	
CM570:	2 parameters at 20 msec = 84 secs of data	7 parameters at 20 msec = 24 secs of data
CM870:	2 parameters at 20 msec = 178 secs of data	16 parameters at 20 msec = 30 secs of data

Advantages of IDL :

Not limited to block transfer capability (sets of 3)
SPEED !!! 20 msec (CM570/CM870) capability.
Center buffer or fill buffer or stop buffer modes.
Calterm is user-friendly, doesn't require knowledge of Calterm scalars.
Monitor Parameters listed in TROUBLESHOOTING AND DIAGNOSTICS PARAMETER GUIDE section of
CM870 Common Approach To Diagnostics is equally applicable to IDL as for Calterm external (Monitor) logs.
Can monitor activities on Monitor screen and activate IDL when necessary
Can use both Monitor datalogger and IDL simultaneously. You must stop Monitor logger before extracting data from IDL.

Disadvantages of IDL:

Requires unsecured module: security risks are increased
Manual processing time is increased for the engineer to extract each set of data
Requires renaming the file if multiple logs are required
Larger buffer (CM870) is slower to extract data (approx. 1 minute)
Very small buffer size limit the practical length of data logs
Sometimes can lock up during process, may require reboot of Calterm/PC
Less user-friendly in setup mode than for Calterm monitor

ECM BUFFER SIZE

Buffer size: The internal datalogger buffer is a zone of ECM memory for specific diagnostic needs. The buffer size is different size for each product:

CM570: 16 k bytes
CM870: 32 k bytes
Note: ECM must be unsecured and running from RAM prior to moving to IDL mode

For further help: Calterm 7.63 User Manual offers 4 pages of helpful instructions on setting up and using IDL
The CT manual is online on the Calterm web page at http://etools.ctg.cummins.com/products/calterm/

Hints:
Right/Left arrow to adjust logging interval (.020, .040, .060,.080,.100,.120, etc. msec)
Foreground mode = time based
Interrupt mode = every cam EPS event
Alt-F8 to toggle between monitor mode and IDL screen
F6 or F5 or F4 (fill, center, stop buffer) command is available in monitor screen
F2 (+ M) moves parameters from Calterm monitor screen to IDL screen
Stop Broadcast - after key-on (after each key-on) may yield faster extraction

CALTERM HELPFUL HINTS

Use ALT-F1 to bring up an interface screen to enter desired parameters. F1 still functions in this screen to search for parameter names. Use ALT-C to copy a parameter name or use ALT-P to past a variable name to a field region. When done with entering parameter names, hit ENTER to return to the monitor screen. The current screen will be updated with the new parameter list generated.

IDL parameter names can be imported into the IDL set-up screen. Save text file with parameter names to files XXXXXXXX.IDL. Use up to 16 parameter names. This is useful when running several tests and importing different parameters to datalog.

One may take a datalog from the monitor screen and take an IDL log simultaneously. To do this, set-up the IDL screen first and place in RUN DATALOGGER Mode. ESC to the monitor screen and set-up the monitor screen. Start the monitor datalogger. When an event occurs to collect IDL data, use F4, F5, or F6 to start the IDL. Once the IDL is complete, stop the monitor datalogger then upload the IDL data from the buffer in the IDL screen.

TROUBLESHOOTING AND DIAGNOSTICS PARAMETER GUIDE

THE FOLLOWING INDEX IDENTIFIES AVAILABLE CONTROL SYSTEM PARAMETERS

Engine Platforms: ENFORCER 02 / ISM 02
ECM: PV CM870 Application Software: Phase 5.4

2002 CM870 Controls System

1. Mission Data Critical Parameters List
   - *Standard Performance Duty Cycle List*
   - *Engine Performance Parameter List*
   - *Air Handling Combustion Controls Parameter List*

A/D Sensors:

2. Ambient Air Pressure / Compressor Inlet Pressure
3. Compressor Inlet Temperature / Ambient Air Temp.
4. Exhaust Pressure Sensor
5. EGR Orifice Temperature (EGR Return Temp.)
6. EGR Valve Position Sensor
7. EGR Delta Pressure Sensor
8. Charge Pressure Sensor / Boost Pressure
9. Charge Temperature Sensor / IMT
10. Turbocharger VG Actuator
11. Turbocharger Speed Processing
12. Coolant Temperature Sensor
13. Coolant Level Sensor
14. Oil Temperature Sensor
15. Oil Pressure Sensor
16. Fuel Rail Pressure Sensor
17. Fuel Temperature Sensor
18. EPS (Engine Position / Engine Speed) Sensors

Virtual Sensors:

19. EGR Fraction Estimation
20. Charge Flow Estimation
21. Exhaust Temperature Estimation
22. Exhaust Pressure Estimation
23. Compressor Outlet Temperature Estimation
24. Compressor Inlet Density Estimation
25. Delta Pressure Estimation
26. EGR Delta Pressure Autozero
27. Ambient Parameters Estimation
28. Saturation Temperature Estimation
29. IMT Prediction / IMT Lead-Lag Compensation
30. EGR Return Temperature Lead-Lag Compensation
31. Charge Temperature Estimation
32. Charge Pressure Estimation
33. Turbo Speed Estimation

Emission Features:

34. Torque Manager (TQM)
35. Torque Parameter Determination (TQP)
36. Net Engine Torque Estimation
37. Pumping Torque Estimation
38. Combustion Manager (CBM)
39. Combustion Parameter Determination (CBP)
    - Residual Mass Estimator
    - *In-Cylinder Oxygen Estimator*
    - *Air / Fuel and Charge / Fuel Calculations*
    - *OFC Fuel Limit Estimator*
    - *Texhaust Fuel Limit Estimator*
    - *Net Engine Torque Estimator*
40. Combustion Reference (CBR)
    - Combustion Fuel Reference with Transient Correction
    - *Chi Reference Determination*
    - *Combustion Reference Baseline*
    - *EGR Fraction Reference with Transient Correction*
    - *Mass Charge Flow (MCF) Reference*
    - *SOI Reference with Transient Correction*
    - *Charge Temperature Reference*
    - *Chi4 Combustion Reference*
    - *Chi Max Fuel Limit*
41. Compensate For Off Nominal Combustion Conditions (CBO)
42. Combustion Limit Management (CBL)
43. Charge Manager (CHM)
44. Charge Parameter Determination (CHP)
45. Charge Limit Management (CHL)
46. Determine Charge System Errors (CSE)

Emission Features:

47. Emissions Manager (EMM)
48. Emission Reference (EMR)
49. Compensate for Off-Nominal Emissions (EMO)

Emission Controls AECDs:

50. Condensation Protection AECD
51. Air Handling System Protection AECD
52. Extreme Ambient Overheat AECD
53. White Smoke / Misfire AECD
54. Extended Idle / PTO AECD
55. General Engine Protection AECD
56. Engine Starting / Warm-up AECD
57. Charge System Engine Protection
58. EGR System Monitor
    - *EGR Cooler Fouling Diagnostics*
59. EGR Valve Position Command
60. EGR Valve Position Autozero
61. VG Turbocharger Duty Cycle
62. VG Air Shutoff Valve Controls

Performance Diagnostics:

63. Charge Flow Derate [Charge Limit Manager (CHL)]
64. Oxygen / Fuel Control (OFC) Fuel Limit
65. Exhaust Temperature (Texh) Fuel Limit
66. Chi Determination
67. Altitude Performance
68. EGR On Conditions
69. EGR Off Conditions
70. EGR Valve Controller
71. VGT Pneumatic Controller
72. EGR Motor Diagnostics
73. EGR Delta P Sensor Diagnostics
    - EGR Delta P In-Range Rationality Diagnostics
    - *EGR Delta P Keyon Pressure Check*
74. Torque Manager Derates

TROUBLESHOOTING AND DIAGNOSTICS PARAMETER GUIDE

THE FOLLOWING INDEX IDENTIFIES AVAILABLE CONTROL SYSTEM PARAMETERS

Engine Platforms: ENFORCER 02 / ISM 02
ECM: PV CM870 Application Software: Phase 5.4

2002 CM870 Controls System

Performance Diagnostics:

ETIF Performance Evaluation:
75. EGR Valve and VGT Performance
76. Engine Brake Performance
77. Clutch Engagement Performance
78. Engine Lug-Up / Lug-Down
79. Torque Response
80. Coupled-Controller Performance During Gear Shifts
81. Coolant and IMT Advance Controls
82. PTO Response
83. Snap Throttle Response (HSG/LSG Stationary)
84. Engine Start-up
85. Low Idle Stability, Stationary
86. PTO Pump-Off
87. Throttle Characterization
88. Snap Throttle Response (HSG Bobtail)
89. Throttle Control / Stability, Bobtail
90. Idle In Gear, Bobtail
91. Gear Ratio Validation
92. Cruise Control Base Functionality
93. Road Speed Governor Base Functionality
94. Cruise Control with Autoresume
95. Cruise Control with Engine Braking
96. Cruise Control Overshoot
97. Road Speed Governor Overshoot
98. Reverse ESP / Take-Off ESP
99. High Idle Stability, Loaded Trailer
100. Throttle Control / Stability, Loaded Trailer
101. Idle In Gear, Loaded Trailer
102. Sensor Characterization
103. Surge Characterization
Air Handling Controller Induced Surge
Quasi-Steady State Compressor Surge
Transient Compressor Surge
Engine Surge
104. OFC and Texh Fuel Limits
105. Dyno Performance Monitor

Application Features:

106. NDOT Governor
107. All Speed Governor (ASG)
108. High Idle Governor (HSG)
109. Low Idle Governor (LSG)
110. Throttle Governor (Min/Max)
111. Power Take-Off Governor (PTO)
112. Road Speed Governor (RSG)
113. Cruise Control Governor (CC)
114. SOI Timing Control
115. SOI Timing Control – SOI Advance
116. Engine Start-up / Cranking
117. Engine Brake Manager
118. Engine Fan Control
119. Alpha Determination
120. Noise Control – Speed Derates
121. Smart Torque (ST Ratings)
122. Load Based Speed Control (LBSC)
Shift Manager (SM)
Machine Mass Estimator (MME)
123. CORS
124. Automated Transmissions
125. Powertrain Controls
126. Powertrain Protection
127. Limp Home Mode
128. Out Of Gear Protection
129. Gear Down Protection
130. Starter Lockout
131. Remote Throttle Control
132. Remote PTO Control
133. Idle Shutdown
134. Turboconveyor
135. Ether Start Injection

Engineering Features:

136. User Overrides
137. Torque To Fuel Conversion
138. Keyon Pressure Check Diagnostics
139. General Engine Protection (EPF)
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Coolant Temperature
Coolant Temp2
EGR Orifice Return Temperature
EGR Orifice Return Temp2
Exhaust Temperature
Intake Manifold Temperature
Oil Pressure
Oil Temperature
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HPI-TP Fuel System:

142. Fuel Systems Interface (FSI)
143. Engine Speed Processing (EPS)
144. Fuel Pressure Compensation (PCC)
145. Fuel Temperature Compensation (TCC)
146. Boost Pressure Compensation (BPC)
147. Solid Fuel Height Determination (SFH)
148. Estimated Valve Delay (EVD)
149. Flow-To-Time Conversion (FTT)
150. Cylinder Cut-Out Diagnostics (CTS)
151. Cylinder Balancing Diagnostics (CBD)
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153. Fuel Shut Off (FSO) Controls
154. Fuel System Fault Derate Handler (FDH)
155. CBD / UFD Based Unintended Fueling Diag. (CUFD)

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THE FOLLOWING INDEX IDENTIFIES AVAILABLE CONTROL SYSTEM PARAMETERS

Engine Platforms: ENFORCER 02 / ISM 02
ECM: PV CM870 Application Software: Phase 5.4

2002 CM870 Controls System

Legacy Information:

156. Hard Starting / Startup and Overshoot
157. Cold Starting
158. Clutch Engagement / Idle Overshoot
159. Throttle Control – Min/Max (Auto) Governor
160. Throttle Control – All Speed (VS) Governor
161. Cruise Control / Road Speed / Geardown Gov.
162. Cruise Control with Engine Brakes
163. Cruise Control with Autoresume
164. Engine Braking
165. Low Power – Road Speed Governor
166. Low Power – Geardown Protection
167. Low Power – Boost Response Test
168. Throttle Characterization / Idle Validation Switches
169. Low Idle Stability / Rough Idle
170. PTO Response / Stability
171. No Load Friction / Light Load Throttle
172. Turbo Surge
173. Performance (Hill Climbing)
174. VSS Anti-Tampering
175. Acceleration Noise Control
176. Cold Temp Stumble / IMT SOI Advance (White Smoke)
177. Road Speed Governor / Cruise Control Dropout
178. High Speed Governor Stability
179. Stumble During Rapid Accel (OFC Limitation)
180. Ambient Air Pressure Sensor – Poor Engine Performance
181. Stationary Engine Brake Delay Test
182. Fan Logic Activation
183. ECM Trip Info / Fuel Economy Activation
184. Datalink Torque Calculation
185. Integrated Centinel (CORS)
186. Starter Lockout
187. Fan Control
188. Anti-Theft
189. Cab Switchable Governor
190. Driver Reward
191. FSSC: Cylinder Cut-Out
192. Powertrain Protection
193. Smart Road Speed Governor
194. J1939 Devices / Eaton Autoshift
195. Highway Cruise Strategy Data Collection
196. Duty Cycle Logging Of Route

2002 CM870 CONTROL SYSTEM

Critical Parameters List:

1. Mission Data Critical Parameters List

Standard Performance Duty Cycle List:

Filtered_Engine_Speed	RPM	Compressor_Inlet_Tmptr	DEG_F
Total_Fueling	MG/STROKE	EGR_Position	%open
Fueling_Control_State_Value	---	VGT_Duty_Cycle	%DutyCycle
Road_Speed	MPH	Filtered_Turbo_Speed	KRPM
Alpha	---	EGR_Fraction	---
CBR_Chi_Value	---	CHL_EGR_Frac_Cmd	---
Exhaust_Press	IN_HG	Charge_Flow	LB/MIN
Charge_Press	IN_HG	CHL_MCF_Cmd	LB/MIN
Commanded_Throttle	%THROTTLE	Final_Timing_State	---
TQM_Final_Torque_Cmd	FT*LB	Final_Timing	DEG_BTDC
Exhaust_Tmptr	DEG_F	Compressor_Inlet_Press	IN_HG
EGR_Orifice_Tmptr	DEG_F	Compressor_Inlet_Density	LBM/FT3
Charge_Tmptr	DEG_F	Altitude	FT
Ambient_Air_Press	IN_HG	EGR_Valve_Delta_Press	IN_HG
Ambient_Air_Tmptr	DEG_F	EGR_Orifice_Delta_Press	IN_HG
Fuel_Rail_Press	PSI	Compressor_Outlet_Tmptr	DEG_F
Fuel_Tmptr	DEG_F	Coolant_Tmptr	DEG_F
Oil_Tmptr	DEG_F	EMM_AECD_State	---
Oil_Press	PSI (gauge)	EMM_Protection_State	---

Engine Performance Parameter List:

Filtered_Engine_Speed	RPM	Ndot_Demand	RPM/SEC
Total_Fueling	MG/STROKE	Ndot_Actual	RPM/SEC
Fueling_Control_State_Value	---	Ndot_LSG	RPM/SEC
Final_Timing	CRANK_DEG	Ndot_HSG	RPM/SEC
Net_Engine_Torque	FT*LB	Ndot_Four_D	RPM/SEC
Net_Machine_Torque	FT*LB	Ndot_ASG	RPM/SEC
No_Load_Torque	FT*LB	Ndot_Cruise_Control	RPM/SEC
Ndot_Error	RPM/SEC	Ndot_RSG	RPM/SEC
Final_Timing_State	---	Filtered_Turbo_Speed	KRPM
Commanded_Throttle	%THROTTLE	Coolant_Tmptr	DEG_F
Road_Speed	MPH	Charge_Tmptr	DEG_F
Filtered_Gear_Ratio	---	Charge_Press	IN_HG
Alpha	---	Ambient_Air_Tmptr	DEG_F
CBR_Chi_Value	---	Ambient_Air_Press	IN_HG
EGR_Position	%open	Compressor_Inlet_Tmptr	DEG_F
VGT_Duty_Cycle	%DutyCycle	Compressor_Inlet_Density	LBM/FT3

Air Handling Combustion Controls Parameter List:

Filtered_Engine_Speed	RPM	CHL_EGR_Frac_Cmd	---
FSS_Total_Fueling	MG/STROKE	EGR_Fraction	---
Fueling_Control_State_Value	---	EAC_EGR_Valve_Cmd	%
TQM_Final_Torque_Cmd	FT*LB	EGR_Position	%open
Net_Engine_Torque	FT*LB	CHS_MCF_Cmd	LB/MIN
CBR_Alpha	---	CHL_MCF_Cmd	LB/MIN
CBR_Chi_Value	---	Charge_Flow	LB/MIN
Filtered_Turbo_Speed	KRPM	TGC_VT_Cmd	%
EGR_Valve_Delta_Press	IN_HG	VGT_Duty_Cycle	%DutyCycle
Charge_Press	IN_HG	CSE_Xform_Error_1	---
Exhaust_Press	IN_HG	CSE_Xform_Error_2	---
Exhaust_Tmptr	DEG_F	CSE_Xform_Angle	DEG
EGR_Orifice_Tmptr	DEG_F	EGR_Delta_Press	IN_HG
Compressor_Outlet_Tmptr	DEG_F	Charge_Tmptr	DEG_F
Compressor_Inlet_Density	LBM/FT3	CBR_EGR_Frac_Ref	---
Compressor_Inlet_Tmptr	DEG_F	CBR_MCF_Ref	LB/MIN
EGA_Control_State	---	EMM_AECD_State	---
Altitude	FT	EMM_Protection_State	---

A/D Sensors:

2. Ambient Air Pressure / Compressor Inlet Pressure

A/D Processing:		*Input to Control Algorithms:*	
Air_Pressure_Sensor	IN_HG	Ambient_Air_Press	IN_HG
Air_Pressure_Sensor_Raw	CNTS	Ambient_Air_Press_Source	---
Air_Pressure_Sensor_Global_Default	IN_HG	Air_Press_State	HEX
Air_Press_Sensor	IN_HG	Compressor_Inlet_Press	IN_HG
Air_Press_Status	---	Compressor_Inlet_Press_Source	---
Air_Pressure_Sensor_High_Error	---	Compressor_Inlet_Pressure_Drop	IN_HG
Air_Pressure_Sensor_Low_Error	---	T_AMB_Sensing_Ambient_Pressure	---

3. Compressor Inlet Temperature / Ambient Air Temperature

A/D Processing:		*Input to Control Algorithms:*	
Compressor_Inlet_Temperature	DEG_F	Compressor_Inlet_Tmptr	DEG_F
Compressor_Inlet_Temperature_Raw	CNTS	Compressor_Inlet_Tmptr_Source	---
Compressor_Inlet_Temperature_Global_Default	DEG_F	Compressor_Inlet_Tmptr_State	HEX
Compressor_Inlet_Tmptr_Sensor	DEG_F	Ambient_Air_Tmptr	DEG_F
Compressor_Inlet_Tmptr_Status	---	Ambient_Air_Tmptr_Source	---
Compressor_Inlet_Temperature_Low_Error	---	Compressor_Inlet_Tmptr_Rise	DEG_F
Compressor_Inlet_Temperature_High_Error	---		

4. Exhaust Pressure Sensor

A/D Processing:		*Input to Control Algorithms:*	
Exhaust_Pressure_Sensor	IN_HG	Exhaust_Press	IN_HG
Exhaust_Pressure_Sensor_Raw	CNTS	Exhaust_Press_Source	---
Exhaust_Pressure_Sensor_Global_Default	IN_HG	Exhaust_Press_State	HEX
Exhaust_Press_Sensor	IN_HG	Exhaust_Pressure	IN_HG
Exhaust_Press_Status	---		
Exhaust_Pressure_Sensor_High_Error	---		
Exhaust_Pressure_Sensor_Low_Error	---		

5. EGR Orifice Temperature (EGR Return Temperature)

A/D Processing:		*Input to Control Algorithms:*	
EGR_Orifice_Temperature	DEG_F	EGR_Orifice_Temperature	DEG_F
EGR_Orifice_Temperature_Raw	CNTS	EGR_Orifice_Tmptr_Source	---
EGR_Orifice_Temperature_Global_Default	DEG_F	EGR_Orifice_Tmptr_State	HEX
EGR_Orifice_Tmptr_Sensor	DEG_F	EGR_Orifice_Tmptr	DEG_F
EGR_Orifice_Tmptr_Status	---	*EGRT Lead Lag Estimation:*	
EGR_Orifice_Temperature_Sensor_High_Error	---	INM_EGRT_Lead_Term	DEG_F
EGR_Orifice_Temperature_Sensor_Low_Error	---	INM_EGRT_After_Lead	DEG_F
		INM_EGRT_Lead_Time_Constant	SEC

6. EGR Valve Position Sensor

A/D Processing:		*Output from EGR Position Autozero:*	
EGR_Position_Before_Autozero	%open	EGR_Position	%open
EGR_Position_Before_Autozero_Raw	CNTS	EGR_Position_Source	---
EGR_Position_Before_Autozero_Global_Default	%open	EGR_Position_State	HEX
EGR_Position_Sensor	%open		
EGR_Position_Status	---	EGR_Valve_Position	%open
EGR_Position_Before_Autozero_High_Error	---	EGR_Valve_Is_Closed	---
EGR_Position_Before_Autozero_Low_Error	---	EGR_Valve_Autozero_Error	---

7. EGR Delta Pressure Sensor

A/D Processing:		*Output from EGR □P Autozero:*	
EGR_Delta_P_Sensor	IN_HG	EGR_Delta_Press	IN_HG
EGR_Delta_P_Sensor_Raw	CNTS	EGR_Delta_Press_Source	---
EGR_Delta_P_Sensor_Global_Default	IN_HG	EGR_Delta_Press_State	HEX
EGR_Delta_Press_Sensor	IN_HG		
EGR_Delta_Press_Status	---	EGR_Delta_Press_AP	IN_HG
EGR_Delta_P_Sensor_High_Error	---	EGR_ Delta_Pressure	IN_HG
EGR_Delta_P_Sensor_Low_Error	---	EGR_Delta_P_Autozero_Error	---

8. Charge Pressure Sensor / Boost Pressure

A/D Processing:		*Input to Control Algorithms:*	
Boost_Pressure_Absolute	IN_HG	Charge_Press	IN_HG
Boost_Pressure_Absolute_Raw	CNTS	Charge_Press_Source	---
Boost_Pressure_Absolute_Global_Default	IN_HG	Charge_Press_State	HEX
Charge_Press_Sensor	IN_HG	Boost_Pressure_Absolute	IN_HG
Charge_Press_Status	---	*Gage Boost Pressure Value:*	
Boost_Pressure_Absolute_High_Error	---	Boost_Pressure	IN_HG
Boost_Pressure_Absolute_Low_Error	---	Charge_Press_Gauge	IN_HG
		Charge_Press_Gauge_Source	---

9. Charge Temperature Sensor / Intake Manifold Temperature

A/D Processing:		*Input to Control Algorithms:*	
Intake_Manifold_Temperature_Sensor	DEG_F	Charge_Tmptr	DEG_F
Intake_Manifold_Temperature_Sensor_Raw	CNTS	Charge_Tmptr_Source	---
Intake_Manifold_Temperature_Sensor_Global_Default	DEG_F	Charge_Tmptr_State	HEX
Charge_Tmptr_Sensor	DEG_F	Intake_Manifold_Temperature	DEG_F
Charge_Tmptr_Status	---	*IMT Lead Lag Estimation:*	
Intake_Manifold_Temperature_Sensor_High_Error	---	TPE_IMT_Lead_Term	DEG_F
Intake_Manifold_Temperature_Sensor_Low_Error	---	TPE_IMT_After_Lead	DEG_F
		TPE_IMT_Lead_Time_Constant	SEC

10. Turbocharger VG Actuator

Input to Control Algorithm:		*Output to Control System:*	
Battery_Voltage	VOLT	VGT_Duty_Cycle	%DutyCycle
Coolant_Tmptr	DEG_F	VGT_Dither_Amplitude	%DutyCycle
TGC_VT_Cmd	%	VGT_Duty_Cycle_Dithered	%DutyCycle
		VGT_Battery_Compensated_Duty_Cycle	%DutyCycle
		VGT_Cold_Compensated_Duty_Cycle	%DutyCycle

11. Turbocharger Speed Processing

A/D Processing:		Turbo_Speed_Low_Error	---
Ambient_Air_Press	IN_HG	Turbo_Speed_High_Error	---
Charge_Press	IN_HG		
Estimated_Turbo_Speed	KRPM	*Input To Control Algorithms:*	
Raw_Turbo_Speed	HZ	Filtered_Turbo_Speed	KRPM
Turbo_Speed_Period	SEC	Turbo_Speed_Source	---
Turbo_Speed_Global_Default	KRPM	Turbo_Speed_State	HEX
Turbo_Speed_Sensor	KRPM	VR_Turbo_Speed_Hysteresis	---
Turbo_Speed_Status	---	Turbo_Speed_In_Range_Error	---

12. Coolant Temperature Sensor

A/D Processing:		*Input to Control Algorithms:*	
Coolant_Temperature	DEG_F	Coolant_Tmptr	DEG_F
Coolant_Temperature_Raw	CNTS	Coolant_Tmptr_Source	---
Coolant_Temperature_Global_Default	DEG_F	Coolant_Tmptr_State	HEX
Coolant_Tmptr_Sensor	DEG_F	Coolant_Temperature	DEG_F
Coolant_Tmptr_Status	---		
Coolant_Temperature_High_Error	---		
Coolant_Temperature_Low_Error	---		

13. Coolant Level Sensor

A/D Processing:		*Input to Control Algorithms:*	
Coolant_Level	VOLT	Coolant_Lvl	VOLT
Coolant_Level_Raw	CNTS	Coolant_Lvl_Source	---
Coolant_Level_Global_Default	VOLT	Coolant_Lvl_State	HEX
Coolant_Lvl_Sensor	VOLT	Coolant_Level	VOLT
Coolant_Lvl_Status	---	Coolant_Level_High_Error	---
		Coolant_Level_Low_Error	---
Determining Coolant Level:			
Coolant_Tmptr	DEG_F	CLS_Safe_Threshold	---
CLS_Coolant_Level_State	---	CLS_Coolant_Level_Reading	---
CLS_Low_Coolant_Error	---	T_CLS_Algorithm_Enable	HEX

14. Oil Temperature Sensor

A/D Processing:		*Input to Control Algorithms:*	
Oil_Temperature	DEG_F	Oil_Tmptr	DEG_F
Oil_Temperature_Raw	CNTS	Oil_Tmptr_Source	---
Oil_Temperature_Global_Default	DEG_F	Oil_Tmptr_State	HEX
Oil_Tmptr_Sensor	DEG_F	Oil_Temperature	DEG_F
Oil_Tmptr_Status	---		
Oil_Temperature_High_Error	---		
Oil_Temperature_Low_Error	---		

15. Oil Pressure Sensor

A/D Processing:		*Input to Control Algorithms:*	
Oil_Pressure_Absolute	PSI_A	Oil_Press	PSI
Oil_Pressure_Absolute_Raw	CNTS	Oil_Press_Source	---
Oil_Pressure_Absolute_Global_Default	PSI_A	Oil_Press_State	HEX
Oil_Press_Sensor	PSI_A	Oil_Pressure	PSI
Oil_Press_Status	---		
Oil_Pressure_Absolute_High_Error	---	*Absolute Oil Pressure Value:*	
Oil_Pressure_Absolute_Low_Error	---	Oil_Press_Absolute	PSI_A

HPI-TP Fuel Systems A/D Sensors:

16. Fuel Rail Pressure Sensor

A/D Processing:		*Input to Control Algorithms:*	
Fuel_Rail_Pressure	PSI	Fuel_Rail_Pressure	PSI
Fuel_Rail_Pressure_Raw	CNTS	Fuel_Rail_Press	PSI
Fuel_Rail_Pressure_Global_Default	PSI	Fuel_Rail_Press_Source	---
Fuel_Rail_Press_Sensor	PSI		
Fuel_Rail_Press_Status	---	*FSSC Parameters:*	
Fuel_Rail_Pressure_High_Error	---	FSI_lp_Gallery_v	MBAR
Fuel_Rail_Pressure_Low_Error	---		

17. Fuel Temperature Sensor

A/D Processing:		*Input to Control Algorithms:*	
Fuel_Temperature	DEG_F	Fuel_Temperature	DEG_F
Fuel_Temperature_Raw	CNTS	Fuel_Tmptr	DEG_F
Fuel_Temperature_Global_Default	DEG_F	Fuel_Tmptr_Source	---
Fuel_Tmptr_Sensor	DEG_F		
Fuel_Tmptr_Status	---	*FSSC Parameters:*	
Fuel_Temperature_High_Error	---	FSI_t_fuel_v	DEG_C
Fuel_Temperature_Low_Error	---		

18. EPS (Engine Position / Engine Speed) Sensors

EPS Main Sensor (Crank):		*EPS Backup Sensor (Cam):*	
EPS_Main_RPM	RPM	EPS_Backup_RPM	RPM
EPS_Main_Sync_State	---	EPS_Backup_Sync_State	---
EPS_Main_Intermittent_Sync_State	---	EPS_Backup_Intermittent_Sync_State	---
EPS_Main_Interrupt_Number	---	EPS_Backup_Interrupt_Number	---
EPS_Main_Period	---	EPS_Backup_Period	---
EPS_Main_Pulse_Type	---	EPS_Backup_Pulse_Type	---
EPS_Engine_Speed	RPM	EPS_Backup_Phase	CRANK_DEG
EPS_Cam_Cycle_State	---	EPS_Cam_Half_Cycle	---
EPS_Error_Status	HEX	EPS_Crank_Tooth_At_Cam_Pulse	CNTS

Virtual Sensors:

19. EGR Fraction Estimation

Filtered_Engine_Speed	RPM	Total_Fueling	MG/STROKE
Net_Engine_Torque	FT*LB	Fueling_Control_State	---
EGR Fraction Estimate:			
CHP_Volumetric_Efficiency	---	CHP_O2_Frac_EGR	---
CBP_O2_Frac_Residual_Bef_Delay	---	EGR_Flow	LB/MIN
CHP_O2_Flow_Delay	SEC	EGR_Flow_Source	---
CHP_EGR_Flow_Delay	SEC	Charge_Flow	LB/MIN
CHP_EGR_Flow_Before_Delay	LB/MIN	EGR_Fraction	---
Downstream EGR Flow Model:			
EGR_Orifice_Delta_Press	IN_HG	EGR_Position	%open
Charge_Press	IN_HG	EGR_Valve_Is_Closed	---
EGR_Orifice_Tmptr	DEG_F	C_CHP_Venturi_Vrt_Sensor_Active	---
CHP_Downstream_Pratio	---	EGR_Position_Source	---
CHP_Sqrt_Torifice_R	DEG_R	EGR_Orifice_Delta_Press_Source	---
CHP_Downstream_Corrected_Flow	LB/MIN	Charge_Press_Source	---
CHP_Downstream_EGR_Flow	LB/MIN	EGR_Tmptr_Source	---

20. Charge Flow Estimation

Filtered_Engine_Speed	RPM	Total_Fueling	MG/STROKE
Net_Engine_Torque	FT*LB	Fueling_Control_State	---
Charge Flow Estimate:			
Charge_Tmptr	DEG_F	Charge_Press_Source	---
CHP_Intake_Manifold_Tmptr_R	DEG_R	Charge_Tmptr_Source	---
CHP_Volumetric_Efficiency	---	Exhaust_Press_Source	---
Charge_Flow	LB/MIN	Charge_Flow_Source	---
Volumetric Efficiency:			
CHP_Veff_Mach	---	Exhaust_Press	IN_HG
CHP_Veff_Sqrt	---	Charge_Press	IN_HG
CHP_Flow_Area_Constant	---	CHP_Pratio	---
Speed Density Equation:			
CHP_Volumetric_Efficiency	---	CHP_Intake_Manifold_Tmptr_R	DEG_R
Charge_Press	IN_HG	C_CHP_Engine_Displacement	IN3

21. Exhaust Temperature Estimation

Filtered_Engine_Speed	RPM	Total_Fueling	MG/STROKE
Net_Engine_Torque	FT*LB	Fueling_Control_State	---
Exhaust Temperature OPUS-Fit:			
FSS_SOI	CRANK_DEG	Filtered_Engine_Speed	RPM
Charge_Press	IN_HG	CBP_Charge_Fuel_Ratio	---
		TPE_Energy_Fraction	---
Exhaust Temperature Estimate:			
TPE_Invalid_Model	---	Exhaust_Tmptr_Source	---
TPE_Delta_Exhaust_Tmptr	DEG_F	Charge_Flow_Source	---
Exhaust_Tmptr	DEG_F	Charge_Tmptr_Source	---
Exhaust_Metal_Tmptr	DEG_F	Charge_Press_Source	---

22. Exhaust Pressure Estimation

Filtered_Engine_Speed	RPM	Exhaust_Press	IN_HG
Net_Engine_Torque	FT*LB	Exhaust_Press_Source	---
Fueling_Control_State	---	T_TPE_Exhaust_Press_Est_Enable	---
Exhaust Pressure Back-up Estimate:			
Filtered_Engine_Speed	RPM	EGR_Position	%open
TGC_VT_Cmd	%	Charge_Press	IN_HG
		Exhaust_Press_Est	IN_HG
EMP Estimate Source:			
EGR_Position_Source	---	Exhaust_Press_Estat	---
Charge_Press_Source	---		

23. Compressor Outlet Temperature Estimation

Filtered_Engine_Speed	RPM		
Net_Engine_Torque	FT*LB		
COT Estimate:			
Compressor_Inlet_Press	IN_HG	TPE_Corrected_Air_Flow	KG*SQRT_K/S/Mpa
Compressor_Inlet_Tmptr	DEG_F	TPE_CIT_Sqrt	SQRT(DEG_K)
Fresh_Air_Flow	LB/MIN	TPE_Corrected_Turbo_Speed	REV/SEC/SQRT(K)
Filtered_Turbo_Speed	KRPM	TPE_COT_To_Inlet_Tmptr_Ratio	---
		Compressor_Outlet_Tmptr	DEG_F
COT Estimate Source:			
Compressor_Inlet_Press_Source	---	Turbo_Speed_Source	---
Compressor_Inlet_Tmptr_Source	---	TPE_COT_Est_Enable	---
Fresh_Air_Flow_Source	---	Compressor_Outlet_Tmptr_Source	---

24. Compressor Inlet Density Estimation

Filtered_Engine_Speed	RPM		
Net_Engine_Torque	FT*LB		
Compressor Inlet Density Estimate:			
Compressor_Inlet_Press	IN_HG	Compressor_Inlet_Tmptr	DEG_F
		Compressor_Inlet_Density	LBM/FT3
Compressor Inlet Density Source:			
Compressor_Inlet_Press_Source	---	Altitude	FT
Compressor_Inlet_Tmptr_Source	---	CBR_Chi_Value	---
Compressor_Inlet_Density_Source	---		

25. Delta Pressure Estimation

Filtered_Engine_Speed	RPM		
Net_Engine_Torque	FT*LB		
EGR Delta Pressures Estimate:			
Charge_Press	IN_HG	EGR_Valve_Delta_Press	IN_HG
Exhaust_Press	IN_HG	Engine_Delta_Press	IN_HG
EGR_Delta_Press	IN_HG	EGR_Orifice_Delta_Press	IN_HG
EGR Delta Pressures Estimate Source:			
C_CHP_Downstream_Delta_P_Active	---	EGR_Valve_Delta_Press_Source	---
Charge_Press_Source	---	Engine_Delta_Press_Source	---
Exhaust_Press_Source	---	EGR_Orifice_Delta_Press_Source	---
EGR_Delta_Press_Source	---		

26. EGR Delta Pressure Autozero

EGR_Delta_Press_Sensor	IN_HG	EGR_Delta_P_Autozero_Enable	---
EGR_Delta_Press_Status	---	EGR_Delta_P_AZ_Bypass	---
		EGR_Delta_P_AZ_Precondition	---
EGR Delta P Autozero Enabler:			
Coolant_Tmptr_Source	---	Coolant_Tmptr	DEG_F
EGR_Delta_Press_Status	---	Charge_Tmptr	DEG_F
EGR_Position_Source	---	Charge_Tmptr_Source	---
Filtered_Engine_Speed	RPM	EGR_Valve_Is_Closed	---
Keyswitch	---	Filtered_Turbo_Speed	KRPM
EGR Delta P Autozero Logic:			
C_EGR_Delta_P_AZ_Tolerance	%open	T_EGR_Delta_P_Autozero_Offset	IN_HG
C_EGR_Delta_P_AZ_Enable_Time	SEC	EGR_Delta_Press_AP	IN_HG
C_EGR_Delta_P_AZ_Fault_Time	SEC	EGR_Delta_Press	IN_HG
EGR_Delta_P_Autozero_Error	---	EGR_Delta_Press_State	---
EGR_Delta_P_Autozero_Complete	---	EGR_Delta_Press_Source	---

27. Ambient Parameters Estimation

Filtered_Engine_Speed	RPM		
Net_Engine_Torque	FT*LB		
Ambient Temperature Estimate:			
Vehicle_Speed	MPH	Ambient_Air_Tmptr	DEG_F
Fresh_Air_Flow	LB/MIN	Fresh_Air_Flow_Source	---
Compressor_Inlet_Tmptr_Rise	DEG_F	Compressor_Inlet_Tmptr_Source	---
Compressor_Inlet_Tmptr	DEG_F	Ambient_Air_Tmptr_Source	---
Altitude Estimate:			
Ambient_Air_Press	IN_HG	Ambient_Air_Press_Source	---
Altitude	FT	Altitude_Source	---
Compressor Inlet Pressure Estimate:			
Air_Press	IN_HG	Compressor_Inlet_Press	IN_HG
Fresh_Air_Flow	LB/MIN	Fresh_Air_Flow_Source	---
Compressor_Inlet_Pressure_Drop	IN_HG	Air_Press_Source	---
T_AMB_Sensing_Ambient_Pressure	---	Ambient_Air_Press_Source	---
Ambient_Air_Press	IN_HG	Compressor_Inlet_Press_Source	---
Humidity Estimate (engineering use only):			
Filtered_Engine_Speed	RPM	Ambient_Relative_Humidity	---
CBR_Fuel_Ref	MG/STROKE		

28. Saturation Temperature Estimation

Filtered_Engine_Speed	RPM		
Net_Engine_Torque	FT*LB		
Saturation Temperatures Estimate:			
Charge_Press	IN_HG	TPE_Inlet_H2O_Mole_Fraction	---
EGR_Fraction	---	Charge_Saturation_Tmptr	DEG_F
CBR_Base_Chi_EGR_Frac_Cmd	---	Charge_H2O_PP	IN_HG
CBP_Phi	---	Exhaust_Saturation_Tmptr	DEG_F
Ambient_Air_Press	IN_HG	Exhaust_H2O_PP	IN_HG
Ambient_Air_Tmptr	DEG_F	Charge_Press_Source	---
Ambient_Relative_Humidity	---	Ambient_Air_Press_Source	---
TPE_Saturation_Vapor_Press	IN_HG	Ambient_Air_Tmptr_Source	---
TPE_Vapor_Partial_Press	IN_HG	Charge_Saturation_Tmptr_Source	---
TPE_Charge_H2O_Mole_Fraction	---	Exhaust_Saturation_Tmptr_Source	---
TPE_Exhaust_H2O_Mole_Fraction	---		

29. IMT Prediction / IMT Lead-Lag Compensation

Filtered_Engine_Speed	RPM		
Net_Engine_Torque	FT*LB		
IMT Prediction with EGR Flow:			
Ambient_Air_Tmptr	DEG_F	Coolant_Tmptr	DEG_F
CBR_Base_Chi_EGR_Frac_Cmd	---	Exhaust_Tmptr	DEG_F
EGR_Valve_Is_Closed	---	Charge_Tmptr	DEG_F
		CHP_Predicted_IMT	DEG_F
IMT Lead-Lag Compensation:			
Charge_Flow	LB/MIN	TPE_IMT_After_Lead	DEG_F
Charge_Tmptr_Sensor	DEG_F	Charge_Tmptr_State	---
Charge_Tmptr_Status	---	Charge_Tmptr_Est	DEG_F
TPE_IMT_Lead_Time_Constant	SEC	Charge_Tmptr_EStat	---
TPE_IMT_Lead_Term	DEG_F	Charge_Tmptr	DEG_F
		Charge_Tmptr_Source	---

30. EGR Return Temperature Lead-Lag Compensation

Filtered_Engine_Speed	RPM		
Net_Engine_Torque	FT*LB		
EGRT Lead-Lag Compensation:			
EGR_Orifice_Tmptr_Sensor	DEG_F	INM_EGRT_Lead_Term	DEG_F
EGR_Orifice_Tmptr_Status	---	INM_EGRT_After_Lead	DEG_F
EGR_Flow	LB/MIN	EGR_Orifice_Tmptr_State	---
INM_EGRT_Lead_Time_Constant	SEC	EGR_Orifice_Tmptr	DEG_F
		EGR_Orifice_Tmptr_Source	---

31. Charge Temperature Estimation

Compressor_Inlet_Tmptr	DEG_F	CBR_Alpha	---
Compressor_Inlet_Tmptr_Source	---	TPE_CIT_Ref	DEG_F
CBR_Chi_Value	---	CBR_Charge_Tmptr_Ref	DEG_F
CBR_Chi_Desired	---	Charge_Tmptr_Est	DEG_F
CBR_Chi_Source	---	Charge_Tmptr_EStat	---

32. Charge Pressure Estimation

Charge Pressure Estimate Logic:

Filtered_Engine_Speed	RPM	TPE_Corrected_Turbo_Speed	REV/SEC/Sqrt(K)
Compressor_Inlet_Press	IN_HG	Charge_Press_Est_Offset	IN_HG
TPE_Pressure_Ratio_Scale	---	Charge_Press_Tolerance	IN_HG
		Charge_Press_Est	IN_HG

Charge Pressure Estimate Status:

Turbo_Speed_Source	---	EGR_Position_Source	---
Filtered_Turbo_Speed	KRPM	EGR_Delta_Press_Source	---
Compressor_Inlet_Tmptr_Source	---	Exhaust_Press_Source	---
Charge_Tmptr_Source	---	EGR_Orifice_Tmptr_Source	---
Air_Press_Source	---	C_CHP_Downstream_Delta_P_Active	---
		Charge_Press_Estat	---

33. Turbo Speed Estimation

Turbo Speed Estimate Logic:

Filtered_Engine_Speed	RPM	TPE_Turbo_Speed_Scale	---
Charge_Press	IN_HG	TPE_CIT_Sqrt	SQRT(DEG_K)
Compressor_Inlet_Press	IN_HG	Turbo_Speed_Est_Offset	KRPM
TPE_Corrected_Turbo_Speed_Est	REV/SEC/Sqrt(K)	Turbo_Speed_Tolerance	KRPM
		Turbo_Speed_Est	KRPM

Turbo Speed Estimate Status:

Charge_Press_Source	---	Compressor_Inlet_Tmptr_Source	---
Compressor_Inlet_Press_Source	---	Turbo_Speed_EStat	---
Net_Engine_Torque	FT*LB	Filtered_Turbo_Speed	KRPM

Emission Features:

34. Torque Manager (TQM)

[TQM] Torque Manager:

Filtered_Engine_Speed	RPM	Engine_Protection_Derate_Torque	FT*LB
Ndot_Net_Torque_Cmd	FT*LB	TQM_Final_Torque_Cmd	FT*LB
Ndot_Net_Torque_Cmd_State	---	TQM_Net_Engine_Torque_State	---
Throttle_100_Torque	FT*LB	TQM_Net_Machine_Torque_Cmd	FT*LB
Fan_Torque	FT*LB	TQM_Net_Machine_Torque_State	---
AC_Torque	FT*LB		
Altitude_Derate_Torque	FT*LB	TQM_Engine_Torque_Limit	FT*LB
Out_Of_Gear_Torque	FT*LB	TQM_Engine_Torque_Limit_State	---
PTO_Derate_Torque	FT*LB	TQM_Machine_Torque_Limit	FT*LB
PTP_Torque_Output	FT*LB	TQM_Machine_Torque_Limit_State	---
WP_Startup_Torque_Limit	FT*LB	TQM_Net_Engine_Torque_Rqst	FT*LB

[TQM] Max Machine Torque:

Filtered_Engine_Speed	RPM	Torque_Derate_Override_Enable	---
Ndot_Net_Torque_Cmd	FT*LB	C_TQM_No_Derate_Torque	FT*LB
Ndot_Net_Torque_Cmd_State	---		
Throttle_100_Torque	FT*LB	TQM_Machine_Torque_Limit	FT*LB
Out_Of_Gear_Torque	FT*LB	TQM_Machine_Torque_Limit_State	---
PTO_Derate_Torque	FT*LB		
PTP_Torque_Output	FT*LB		

[TQM] Machine Torque Limiting:

Filtered_Engine_Speed	RPM	TQM_Machine_Torque_Limit	FT*LB
Ndot_Net_Torque_Cmd	FT*LB	TQM_Machine_Torque_Limit_State	---
Ndot_Net_Torque_Cmd_State	---		
MS_Control_Flag	---	TQM_Net_Machine_Torque_Cmd	FT*LB
MS_Override_Enable	HEX	TQM_Net_Machine_Torque_State	---
MS_Final_Override_Torque	FT*LB		
Torque_Derate_Override_Enable	---		

[TQM] Max Machine Torque:

Filtered_Engine_Speed	RPM	Torque_Derate_Override_Enable	---
Ndot_Net_Torque_Rqst	FT*LB	C_TQM_No_Derate_Torque	FT*LB
Ndot_Net_Machine_Torque_State	---		
Altitude_Derate_Torque	FT*LB	TQM_Engine_Torque_Limit	FT*LB
Engine_Protection_Derate_Torque	FT*LB	TQM_Engine_Torque_Limit_State	---
WP_Startup_Torque_Limit	FT*LB		

[TQM] Engine Torque Limiting:

Filtered_Engine_Speed	RPM	TQM_Final_Torque_Cmd	FT*LB
Ndot_Net_Torque_Rqst	FT*LB	TQM_Net_Engine_Torque_State	---
Ndot_Net_Machine_Torque_State	---		
TQM_Engine_Torque_Limit	FT*LB		
TQM_Engine_Torque_Limit_State	---		

35. Torque Parameter Determination (TQP)

Filtered_Engine_Speed	RPM	Coolant_Torque_Adjustment	FT*LB
TQM_Final_Torque_Cmd	FT*LB	Friction_Torque	FT*LB
Total_Fueling	MG/STROKE	Net_Machine_Torque	FT*LB
AC_Torque	FT*LB	No_Load_Torque	FT*LB
Fan_Torque	FT*LB	Zero_Fuel_Torque	FT*LB
CHP_Pumping_Torque_Adj	FT*LB		
Net_Engine_Torque	FT*LB		
Coolant_Tmptr	DEG_F		

36. Net Torque Estimation

Combustion Torque Determination:

Filtered_Engine_Speed	RPM	CBP_Adj_Total_Fueling	MG/STROKE
FSS_Total_Fueling	MG/STROKE	Coolant_Torque_Adjustment	FT*LB
CBP_SOI_Torque_Adj_Gain	MG/STROKE	C_CBP_Coolant_Torque_Adj_Factor	---
FSS_SOI	CRANK_DEG	CHP_Pumping_Torque_Adj	FT*LB
CBR_SOI_Alpha1	CRANK_DEG	CBP_Combustion_Torque	FT*LB
SOI_Torque_To_Fuel_Adj	mg/strk/degBTDC	CBP_Net_Combustion_Torque	FT*LB

Net Torque Determination:

CBP_Net_Combustion_Torque	FT*LB	AC_Torque	FT*LB
EBP_EB_Torque	FT*LB	Fan_Torque	FT*LB
E_Brake_Status	---	Net_Engine_Torque	FT*LB
Filtered_Net_Machine_Torque	FT*LB	Net_Machine_Torque	FT*LB

Engine Brake Torque Determination:

Filtered_Engine_Speed	RPM	EBP_Adj_Charge_Flow	LB/MIN
Charge_Flow	LB/MIN	EBP_EB_Torque	FT*LB
EB_Active_Driver_Fraction	---	Jcomm_Ind_Retarder_Torque	FT*LB

No Load Torque Determination:

Filtered_Engine_Speed	RPM	Coolant_Torque_Adjustment	FT*LB
Zero_Fuel_Torque	FT*LB	Friction_Torque	FT*LB
Coolant_Tmptr	DEG_F	CHP_Pumping_Torque_Adj	FT*LB
		No_Load_Torque	FT*LB

TQM_Final_Torque_Cmd	FT*LB	TQM_Net_Engine_Torque_State	---
Fueling_Control_State	---		

37. Pumping Torque Estimation

Filtered_Engine_Speed	RPM		
Net_Engine_Torque	FT*LB		

Pumping Torque Estimate:

Filtered_Engine_Speed	RPM	Engine_Delta_Press	IN_HG
FSS_Total_Fueling	MG/STROKE	CHP_Pumping_Torque_No_Offset	FT*LB
CHP_Nominal_Engine_Delta_P	IN_HG	CHP_Pumping_Torque_Adj	FT*LB
Exhaust_Tmptr	DEG_F	Charge_Tmptr	DEG_F
Exhaust_Press	IN_HG	Charge_Press	IN_HG

Torque Manager:

TQM_Net_Engine_Torque_Cmd	FT*LB	C_CBP_Coolant_Torque_Adj_Factor	---
Coolant_Torque_Adjustment	FT*LB	TQM_Final_Torque_Cmd	FT*LB

38. Combustion Manager (CBM)

Filtered_Engine_Speed	RPM	Total_Fueling	MG/STROKE
TQM_Final_Torque_Cmd	FT*LB	Final_Timing	CRANK_DEG
TQM_Net_Engine_Torque_State	---	CBL_EGR_Frac_Cmd	---
Alpha	---	CBL_MCF_Cmd	LB/MIN
EMM_Protection_State	---		
EMM_Cap_EL_Cmd	---	CBL_Fuel_Ref	MG/STROKE
EB_Charge_Flow_Command	LB/MIN	CBL_SOI_Ref	CRANK_DEG

39. Combustion Parameter Determination (CBP)

[CBP] Combustion Parameter Determination:

Filtered_Engine_Speed	RPM	Net_Engine_Torque	FT*LB
TQM_Final_Torque_Cmd	FT*LB	OFC_Fuel_Limit	MG/STROKE
TQM_Net_Engine_Torque_State	---	Texh_Fuel_Limit	MG/STROKE
CBR_Gross_Fuel	MG/STROKE		

[CBP] Residual Mass Estimator:

Exhaust_Press	IN_HG	Residual_Mass	MG/STROKE
Exhaust_Tmptr	DEG_F	CBP_Residual_Mass	MG/STROKE

[CBP] In-Cylinder Oxygen Estimator:

Filtered_Engine_Speed	RPM	CBP_Air_Mass	MG/STROKE
Total_Fueling	MG/STROKE	CBP_Charge_Mass	MG/STROKE
Charge_Flow	LB/MIN	CBP_Charge_Plus_Fuel_Mass	MG/STROKE
EGR_Flow	LB/MIN	CBP_EGR_Mass	MG/STROKE
CHP_O2_Frac_EGR	---	CBP_O2_Frac_Residual	MG/STROKE
Air_Pressure_Sensor_Low_Error	---	CBP_O2_Mass_Air	MG/STROKE
		CBP_O2_Mass_Burnt	MG/STROKE
CBP_O2_Frac_Residual_Bef_Delay	---	CBP_O2_Mass_Exhaust	MG/STROKE
Total_O2_In_Cylinder	MG/STROKE		

[CBP] Air/Fuel and Charge/Fuel Calculations:

Charge_Flow	LB/MIN	CBP_Air_Fuel_Ratio	---
Fresh_Air_Flow	LB/MIN	CBP_Charge_Fuel_Ratio	---
Fuel_Delivery_Rate_Per_Min	LB/MIN	CBP_Phi	---

[CBP] OFC Fuel Limit Estimator:

Filtered_Engine_Speed	RPM	OFC_Fuel_Limit	MG/STROKE
Total_Fueling	MG/STROKE	OFC_Equiv_Ratio_Limit	---
Total_O2_In_Cylinder	MG/STROKE		
Fueling_Control_State	---		

[CBP] Texhaust Fuel Limit Estimator:

Filtered_Engine_Speed	RPM	TQM_Final_Torque_Cmd	---
Charge_Flow	LB/MIN	Fueling_Control_State	---
Charge_Tmptr	DEG_F	Texh_Fuel_Limit	MG/STROKE
Exhaust_Tmptr	DEG_F	Exhaust_Metal_Tmptr	DEG_F
TPE_Energy_Fraction	DEG_F	TFC_Fuel_Flow_Limit	LB/MIN

[CBP] Net Engine Torque Estimation:

Filtered_Engine_Speed	RPM	Net_Engine_Torque	FT*LB
FSS_Total_Fueling	MG/STROKE	Jcomm_Ind_Retarder_Torque	FT*LB
FSS_SOI	CRANK_DEG	SOI_Torque_To_Fuel_Adj	MG/STROKE
CBR_SOI_Alpha1	CRANK_DEG		
CHP_Pumping_Torque_Adj	FT*LB	CBP_Adj_Charge_Flow	LB/MIN
Coolant_Torque_Adjustment	FT*LB	CBP_Adj_Total_Fueling	MG/STROKE
Charge_Flow	LB/MIN	CBP_Combustion_Torque	FT*LB
EB_Active_Driver_Fraction	---	CBP_EB_Torque	FT*LB
E_Brake_Status	---	CBP_SOI_Torque_Adj_Gain	Mg/strk/degBTDC

40. Combustion Reference (CBR)

[CBR] Combustion Reference:

Filtered_Engine_Speed	RPM	CBR_Alpha	---
TQM_Final_Torque_Cmd	FT*LB	CBR_Fuel_Ref	MG/STROKE
TQM_Net_Engine_Torque_State	---	CBR_Fuel_Ref_State	---
OFC_Fuel_Limit	MG/STROKE	CBR_EGR_Frac_Ref	---
Texh_Fuel_Limit	MG/STROKE	CBR_MCF_Ref	LB/MIN
Alpha	---	CBR_SOI_Ref	CRANK_DEG
Compressor_Inlet_Density	LBM/FT3	CBR_SOI_Alpha1	CRANK_DEG
Coolant_Tmptr	DEG_F	CBR_Base_Chi_SOI_Cmd	CRANK_DEG
FSS_Fueling_Derate_Request	MG/STROKE	Timing_State_Incr	---
SOI_Torque_To_Fuel_Adj	MG/STROKE	CBR_Charge_Tmptr_Ref	DEG_F
EMM_Cap_EL_Cmd	---	CBR_NOx_Target_Ref	G/HP*HR
EMM_Protection_State	---	CBR_FCLR_Ref	---
CBR_Chi_Value	---	OFC_EGR_Disable	---
CBR_Chi_Source	---		

[CBR] Combustion Fuel Reference with Transient Correction:

Filtered_Engine_Speed	RPM	CBR_FCLR_Ref	---
TQM_Final_Torque_Cmd	FT*LB	CBR_FCLR_On	---
TQM_Net_Engine_Torque_State	---	CBR_FCLR_Off	---
OFC_Fuel_Limit	---	OFC_EGR_Disable	---
Texh_Fuel_Limit	---	CBR_Gross_Fuel_Before_Adj	MG/STROKE
Compressor_Inlet_Density	LBM/FT3	CBR_SOI_Adj_Fuel_Active	---
FSS_Fueling_Derate_Request	MG/STROKE	SOI_Torque_To_Fuel_Adj	MG/STROKE
CBR_Gross_Fuel	MG/STROKE	CBR_Density_Max_Fuel	MG/STROKE
CBR_Fuel_Ref	MG/STROKE	CBR_Max_Chi_Fuel	MG/STROKE
CBR_Fuel_Ref_State	---	CBR_Max_Fuel_Limit	MG/STROKE

[CBR] Chi Determination:

Filtered_Engine_Speed	RPM	CBR_Chi_Value	---
TQM_Final_Torque_Cmd	FT*LB	CBR_Chi_Desired	---
TQM_Net_Engine_Torque_State	---	CBR_Chi_Source	---
Compressor_Inlet_Density	LBM/FT3	CBR_Chi_High	---
Coolant_Tmptr	DEG_F	CBR_Chi_Low	---
Alpha	LBM/FT3	CBR_Alpha	---
EMM_Cap_EL_Cmd	---	CBR_EGR_Off	---
EMM_Protection_State	---	CBR_Protection_Chi_Flag	---

[CBR] Combustion Reference Baseline:

CBR_Base_Desired_Chi	---	CBR_Base_EL	G/HP*HR
CBR_Base_Chi	---	CBR_Base_High_Table	---
CBR_Base_Chi_Source	---	CBR_Base_Low_Table	---
CBR_Base_Chi_EGR_Frac_Cmd	---	CBR_Base_Chi_SOI_Cmd	CRANK_DEG

[CBR] EGR Fraction Reference with Transient Correction:

Filtered_Engine_Speed	RPM	CBR_EGR_Frac_Alpha0	---
CBR_Gross_Fuel	MG/STROKE	CBR_EGR_Frac_Alpha1	---
CBR_Fuel_Ref_State	---	CBR_EGR_Frac_Chi2	---
CBR_Alpha	---	CBR_EGR_Frac_Chi3	---
CBR_Chi_Value	---	CBR_EGR_Frac_Chi4	---
CBR_Base_Chi	---	CBR_EGR_Frac_Ref	---
CBR_EGR_Off	---	CBR_Base_Chi_EGR_Frac_Cmd	---
OFC_EGR_Disable	---		

[CBR] Mass Charge Flow (MCF) Reference:

Filtered_Engine_Speed	RPM	CBR_MCF_Alpha0	LB/MIN
CBR_Gross_Fuel	MG/STROKE	CBR_MCF_Alpha1	LB/MIN
CBR_Fuel_Ref_State	---	CBR_MCF_Chi2	LB/MIN
CBR_Alpha	---	CBR_MCF_Chi3	LB/MIN
CBR_Chi_Value	---	CBR_MCF_Chi4	LB/MIN
		CBR_MCF_Ref	LB/MIN

[CBR] SOI Reference with Transient Correction:

Filtered_Engine_Speed	RPM	CBR_SOI_Alpha0	CRANK_DEG
CBR_Fuel_Ref	MG/STROKE	CBR_SOI_Alpha1	CRANK_DEG
CBR_Fuel_Ref_State	---	CBR_SOI_Chi2	CRANK_DEG
CBR_Alpha	---	CBR_SOI_Chi3	CRANK_DEG
CBR_Chi_Value	---	CBR_SOI_Chi4	CRANK_DEG
CBR_Base_Chi	---	CBR_SOI_Ref	CRANK_DEG
OFC_EGR_Disable	---	CBR_OFC_Alpha0_Incr_Flag	---
Timing_State_Incr	---	CBR_Base_Chi_SOI_Cmd	CRANK_DEG

[CBR] Charge Temperature Reference:

Filtered_Engine_Speed	RPM	CBR_Charge_Tmptr_Alpha0	DEG_F
CBR_Fuel_Ref	MG/STROKE	CBR_Charge_Tmptr_Alpha1	DEG_F
CBR_Fuel_Ref_State	---	CBR_Charge_Tmptr_Chi2	DEG_F
CBR_Alpha	---	CBR_Charge_Tmptr_Chi3	DEG_F
CBR_Chi_Value	---	CBR_Charge_Tmptr_Chi4	DEG_F
Charge_Tmptr	DEG_F	CBR_Charge_Tmptr_Ref	DEG_F

[CBR] Chi4 Combustion Reference:

Filtered_Engine_Speed	RPM	CBR_NOx_Alpha0	G/HP*HR
CBR_Fuel_Ref	MG/STROKE	CBR_NOx_Alpha1	G/HP*HR
CBR_Fuel_Ref_State	---	CBR_NOx_Chi2	G/HP*HR
CBR_Alpha	---	CBR_NOx_Chi3	G/HP*HR
CBR_Chi_Value	---	CBR_NOx_Chi4	G/HP*HR
		CBR_NOx_Target_Ref	G/HP*HR

[CBR] Chi Max Fuel Limit:

Filtered_Engine_Speed	RPM	CBR_Max_Fuel_Alpha0	MG/STROKE
TQM_Final_Torque_Cmd	FT*LB	CBR_Max_Fuel_Alpha1	MG/STROKE
TQM_Net_Engine_Torque_State	---	CBR_Max_Fuel_Chi2	MG/STROKE
CBR_Gross_Fuel_Before_Adj	MG/STROKE	CBR_Max_Fuel_Chi3	MG/STROKE
CBR_Alpha	---	CBR_Max_Fuel_Chi4	MG/STROKE
CBR_Chi_Value	---	CBR_Max_Chi_Fuel	MG/STROKE
CBR_Gross_Fuel	MG/STROKE	CBR_Fuel_Ref_State	---

41. Compensate For Off-Nominal Combustion Conditions (CBO)

Filtered_Engine_Speed	RPM	CBO_EGR_Frac_Ref	---
TQM_Final_Torque_Cmd	FT*LB	CBO_MCF_Ref	LB/MIN
CBR_Fuel_Ref	MG/STROKE	CBO_SOI_Ref	CRANK_DEG
Fueling_Control_State	---	CBO_SOI_Adj_Flag	---
CBR_EGR_Frac_Ref	---	CBO_Charge_Aggressiveness_Ref	---
CBR_MCF_Ref	LB/MIN	CBO_bsNOx	G/HP*HR
CBR_SOI_Ref	CRANK_DEG	CBO_Delta_SOI	CRANK_DEG
CBR_Charge_Tmptr_Ref	DEG_F	CBO_SOI_Adj	CRANK_DEG
CBR_Nox_Target_Ref	G/HP*HR	CBO_SOI_Ref_Adj	CRANK_DEG
CBR_FCLR_Ref	---	CBO_EGR_Frac_Adj	---
EGR_Fraction	---	CBO_Delta_EGR_Frac	---
Charge_Flow	LB/MIN	CBO_MCF_Adj	LB/MIN
FSS_SOI	CRANK_DEG	CBO_Delta_MCF	LB/MIN
Charge_Tmptr	DEG_F	CBO_Charge_Tmptr_Adj	DEG_F
CBO_Fuel_Ref	MG/STROKE	CBO_Delta_Charge_Tmptr	DEG_F
		CBO_Composite_Adj	---

42. Combustion Limit Management (CBL)

Filtered_Engine_Speed	RPM	CBL_Fuel_Cmd	MG/STROKE
TQM_Final_Torque_Cmd	FT*LB	CBL_SOI_Cmd	CRANK_DEG
CBO_Fuel_Ref	MG/STROKE	CBL_EGR_Frac_Cmd	---
Fueling_Control_State	---	CBL_MCF_Cmd	LB/MIN
ANC_SOI	CRANK_DEG	SOI_State	---
SOI_State	---	Timing_State_Incr	---
Timing_State_Incr	---		
CBO_SOI_Adj_Flag	---	CBL_Density_MCF_Limit	LB/MIN
CBO_EGR_Frac_Ref	---	CBL_MCF_Ref	LB/MIN
CBO_MCF_Ref	LB/MIN	CBL_SOI_Min_Limit	CRANK_DEG
CBR_OFC_Alpha0_Incr_Flag	---	CBL_SOI_Max_Limit	CRANK_DEG
Compressor_Inlet_Density	LBM/FT3	CBL_SOI_Ref	CRANK_DEG
EGR_Valve_Is_Closed	---	CBL_User_Incr_Flag	---
		SOI_State_Before_CBL	---

43. Charge Manager (CHM)

Filtered_Engine_Speed	RPM	CHL_EGR_Frac_Cmd	---
TQM_Final_Torque_Cmd	FT*LB	CHL_MCF_Cmd	LB/MIN
Total_Fueling	MG/STROKE		
Fueling_Control_State	---	CSE_Xform_Error_1	---
CBL_EGR_Frac_Cmd	---	CSE_Xform_Error_2	---
CBL_MCF_Cmd	LB/MIN	CSE_MCF_Error	LB/MIN
CBO_Charge_Aggressiveness_Ref	---		
EGR_Fraction	---	EAC_EGR_Valve_Cmd	%open
Charge_Flow	LB/MIN	TGC_VT_Cmd	%DutyCycle

44. Charge Parameter Determination (CHP)

Filtered_Engine_Speed	RPM	Charge_Flow	LB/MIN
TQM_Final_Torque_Cmd	FT*LB	EGR_Flow	LB/MIN
CBL_Fuel_Cmd	MG/STROKE	EGR_Fraction	---
Fueling_Control_State	---	Fresh_Air_Flow	LB/MIN
		CHP_Pumping_Torque_Adj	FT*LB
		CHP_Predicted_IMT	DEG_F

45. Charge Limit Management (CHL)

Filtered_Engine_Speed	RPM	CBL_EGR_Frac_Cmd	---
FSS_Total_Fueling	MG/STROKE	CHL_EGR_Frac_Cmd	---
TQM_Final_Torque_Cmd	FT*LB	CHL_EGR_Frac_Cmd_With_Shutoff	---
Fueling_Control_State	---		
Compressor_Inlet_Density	LBM/FT3	CHL_Derate_Is_Active	---
Charge_Flow	LB/MIN	CHL_COT_Drt_Active	---
CHS_MCF_Cmd	LB/MIN	CHL_COT_Drt_Offset	LB/MIN
CHL_MCF_Cmd	LB/MIN	CHL_Delta_P_Drt_Active	---
Filtered_Turbo_Speed	KRPM	CHL_Delta_P_Drt_Offset	LB/MIN
CHL_Turbo_Drt_Limit	KRPM	CHL_Turbo_Speed_Drt_Active	---
Compressor_Outlet_Tmptr	DEG_F	CHL_Turbo_Speed_Drt_Offset	LB/MIN
EGR_Valve_Delta_Press	IN_HG		

46. Determine Charge System Errors (CSE)

Filtered_Engine_Speed	RPM	CSE_Xform_Error_1	---
TQM_Final_Torque_Cmd	FT*LB	CSE_Xform_Error_2	---
FSS_Total_Fueling	MG/STROKE	CSE_MCF_Error	LB/MIN
Fueling_Control_State	---		
CHL_EGR_Frac_Cmd	---	CSE_ERG_Frac_Error	---
EGR_Fraction	---	CSE_Xform_Angle	DEG
CHL_MCF_Cmd	LB/MIN	CSE_Scheduled_Xform_Angle	DEG
Charge_Flow	LB/MIN		

47. Emissions Manager (EMM)

Filtered_Engine_Speed	RPM	EMR_NTE_Flag	---
TQM_Final_Torque_Cmd	FT*LB	EMR_Cap_EL_Ref	---
Total_Fueling	MG/STROKE		
Fueling_Control_State	---	EMM_AECD_State	---
Net_Engine_Torque	FT*LB	EMM_Protection_State	---
Ambient_Air_Tmptr	DEG_F	EMM_Cap_EL_Cmd	---
Altitude	FT		
Alpha	---		
CBO_bsNOx	G/HP*HR		

48. Emission Reference (EMR)

Filtered_Engine_Speed	RPM	Ambient_Air_Tmptr	DEG_F
TQM_Final_Torque_Cmd	FT*LB	Altitude	FT
Total_Fueling	MG/STROKE		
Fueling_Control_State	---	EMR_NTE_Flag	---
Net_Engine_Torque	FT*LB	EMR_Cap_EL_Ref	---

49. Compensate For Off-Nominal Emission Conditions (EMO)

Filtered_Engine_Speed	RPM	EMO_Air_Handling_Cap_EL	---
Filtered_Turbo_Speed	KRPM	EMO_Air_Handling_AECD_Active	---
Net_Machine_Torque	FT*LB	EMO_Extreme_Amb_Cap_EL	---
Ambient_Air_Tmptr	DEG_F	EMO_Extreme_Amb_AECD_Active	---
Altitude	FT	EMO_Condensation_Cap_EL	---
Compressor_Outlet_Tmptr	DEG_F	EMO_Condensation_AECD_Active	---
Exhaust_Tmptr	DEG_F	EMO_White_Smoke_Cap_EL	---
Coolant_Tmptr	DEG_F	EMO_White_Smoke_AECD_State	---
Charge_Tmptr	DEG_F	EMO_Extended_Idle_Cap_EL	---
Charge_Flow	LB/MIN	EMO_Extended_Idle_AECD_Active	---
Charge_H2O_PP		EMO_Engine_Start_Cap_EL	---
Exhaust_H2O_PP		EMO_Engine_Start_AECD_Active	---
CHP_Predicted_IMT	DEG_F	EMO_Gen_Protect_Cap_EL	---
Engine_Is_Active	---	EMO_Gen_Protect_AECD_State	---
Engine_Is_Starting	---		
EMR_Cap_EL_Ref	---	EMM_Cap_EL_Cmd	---
		EMM_AECD_State	---
		EMM_Protection_State	---

Emission Controls AECDs:

50. Condensation Protection AECD

Filtered_Engine_Speed	RPM	EMO_Condensation_Cap_EL	---
Total_Fueling	MG/STROKE	EMO_Condensation_AECD_Active	---
Fueling_Control_State	---	EMM_AECD_State	---
Charge_Flow	LB/MIN	EMM_Protection_State	---
Charge_H2O_PP	IN_HG		
Exhaust_H2O_PP	IN_HG	EMO_Cooler_Cond_Delta_T	DEG_F
CHP_Predicted_IMT	DEG_F	EMO_Cond_AECD_Timer_Active	---
Coolant_Tmptr	DEG_F	EMO_Cooler_Cond_Adj_Off_Gain	---
Engine_Is_Active	---	EMO_Cooler_Cond_Adj_On_Gain	---
		EMO_Cooler_Cond_AECD_Active	---
Charge_Saturation_Tmptr	DEG_F	EMO_Cooler_Cond_AECD_Possible	---
Exhaust_Saturation_Tmptr	DEG_F	EMO_Intake_Cond_Delta_T	DEG_F
EMO_Cooler_Cond_Count	CNTS	EMO_Intake_Cond_Adj_Off_Gain	---
EMO_Intake_Cond_Count	CNTS	EMO_Intake_Cond_Adj_On_Gain	---
		EMO_Intake_Cond_AECD_Active	---
		EMO_Intake_Cond_AECD_Possible	---

51. Air Handling System Protection AECD

Filtered_Engine_Speed	RPM	EMO_Air_AECD_Level_1	---
Filtered_Turbo_Speed	KRPM	EMO_Air_AECD_Level_2	---
Net_Machine_Torque	FT*LB	EMO_Air_AECD_Level_2_Allowed	---
Ambient_Air_Tmptr	DEG_F	EMO_Air_AECD_Level_3	---
Altitude	FT	EMO_Air_AECD_Level_3_Allowed	---
Compressor_Outlet_Tmptr	DEG_F	EMO_Air_Handling_COT_Limit	DEG_F
Exhaust_Tmptr	DEG_F	EMO_Air_Handling_Near_Limit	---
		EMO_Air_Handling_Speed_Limit	KRPM
EMO_Air_Handling_Cap_EL	---	EMO_Air_Handling_Texh_Limit	DEG_F
EMO_Air_Handling_AECD_Active	---	EMO_High_Load	---
EMM_AECD_State	---	EMO_Near_COT_Limit	---
EMM_Protection_State	---	EMO_Near_Speed_Limit	---
		EMO_Near_Texh_Limit	---

52. Extreme Ambient Overheat AECD

Filtered_Engine_Speed	RPM	EMO_Extreme_Amb_Cap_EL	---
TQM_Final_Torque_Cmd	FT*LB	EMO_Extreme_Amb_AECD_Active	---
Total_Fueling	MG/STROKE	EMM_AECD_State	---
Fueling_Control_State	---	EMM_Protection_State	---
Coolant_Tmptr	DEG_F		

53. White Smoke / Misfire AECD

Filtered_Engine_Speed	RPM	Coolant_SOI_Advance	CRANK_DEG
TQM_Final_Torque_Cmd	FT*LB	IMT_SOI_Advance	CRANK_DEG
Total_Fueling	MG/STROKE	CBR_Base_Chi_SOI_Cmd	CRANK_DEG
Fueling_Control_State	---		
Final_Timing	CRANK_DEG	EMO_White_Smoke_Cap_EL	---
Final_Timing_State	---	EMO_White_Smoke_AECD_State	---
Coolant_Tmptr	DEG_F	EMM_AECD_State	---
Charge_Tmptr	DEG_F	EMM_Protection_State	---

54. Extended Idle / PTO AECD

Filtered_Engine_Speed	RPM	EMO_Extended_Idle_Cap_EL	---
Engine_Is_Active	---	EMO_Extended_Idle_AECD_Active	---
Ndot_Net_Torque_Cmd_State	---	EMM_AECD_State	---
Ndot_Net_Torque_Cmd	FT*LB	EMM_Protection_State	---

55. General Engine Protection AECD

Filtered_Engine_Speed	RPM	CLS_Low_Coolant_Error	---
Fueling_Control_State	---	Turboconveyor_Is_Active	---
CHH_EGR_System_Failure	---	EMO_Gen_Protect_AECD_State	---
CHH_VGT_System_Failure	---	EMO_Gen_Protect_Cap_EL	---
CHH_Major_Engine_Protection	---	EMM_AECD_State	---
CHH_Minor_Engine_Protection	---	EMM_Protection_State	---

56. Engine Starting / Warm-Up AECD

Filtered_Engine_Speed	RPM	EMO_Engine_Start_Cap_EL	---
Fueling_Control_State	---	EMO_Engine_Start_AECD_Active	---
Engine_Is_Starting	---	EMM_AECD_State	---
		EMM_Protection_State	---

57. Charge System Engine Protection

Filtered_Engine_Speed	RPM	CHH_VGT_System_Failure	---
Total_Fueling	MG/STROKE	CHH_EGR_System_Failure	---
Net_Engine_Torque	FT*LB	TQM_Final_Torque_Cmd	FT*LB
Fueling_Control_State	---	TQM_Current_Max_Derate_Torque	FT*LB
Ambient_Air_Press	IN_HG	TQM_Current_No_Derate_Torque	FT*LB
Air_Press_Source	---		
Exhaust_Press	IN_HG	CHH_Sensor_Fault_Derate_Index	---
Exhaust_Press_Source	---	CHH_Charge_Mgr_Derate_Torque	FT*LB
Charge_Press	IN_HG	CHH_Major_Engine_Protection	---
Charge_Press_Source	---	CHH_Minor_Engine_Protection	---
Charge_Tmptr	DEG_F		
Charge_Tmptr_Source	---		

58. EGR System Monitor (CHH)

Filtered_Engine_Speed	RPM	EGR_Orifice_Tmptr	DEG_F
FSS_Total_Fueling	MG/STROKE	EGR_Orifice_Tmptr_Source	---
Fueling_Control_State	---	C_CHH_EGRT_Disable_Thd	DEG_F
Charge_Press	IN_HG	C_CHH_EGRT_Enable_Thd	DEG_F
Charge_Press_Source	---	EGA_Temperature	DEG_F
Charge_Tmptr	DEG_F	EGA_Over_Temperature	---
Charge_Tmptr_Source	---	EGA_Valve_Fault_Over_Tmptr	---
Eshaust_Press	IN_HG	EGR_Motor_Current	AMP
Exhaust_Press_Source	---	EGA_Driver_Over_Current	---
EGR_Position	%open	EGA_Electrical_Fault	---
EGR_Position_Source	---	CHH_EGR_System_Failure	---
EGR_Delta_Press	IN_HG	CHH_CBO_Off	---
EGR_Delta_Press_Source	---		
		EGA_Zero_Hold_Status	---
		T_EGA_Cycle_Counter	CNTS

[CHH] EGR Cooler Fouling Monitor:

Filtered_Engine_Speed	RPM	Coolant_Tmptr_Source	---
Total_Fueling	MG/STROKE	Exhaust_Tmptr_Source	---
Fueling_Control_State	---	EGR_Orifice_Tmptr_Source	---
Coolant_Tmptr	DEG_F	EGR_Flow_Source	---
Exhaust_Tmptr	DEG_F	EGR_Cooler_Fouling_Precondition	---
EGR_Orifice_Tmptr	DEG_F	EGR_Cooler_Eff	%
EGR_Flow	LB/MIN	EGR_Cooler_Eff_Thd	%
CHH_EGR_Cooler_Fouled	---	EGR_Cooler_Fouling_Fault_Count	SEC

59. EGR Valve Position Command

Filtered_Engine_Speed	RPM	EAC_EGR_Valve_Cmd	%open
TQM_Final_Torque_Cmd	FT*LB	EGR_ Position	%open
Total_Fueling	MG/STROKE	EAC_Adjusted_I_Gain	---
Fueling_Control_State	---	EAC_Adjusted_P_Gain	---
Charge_Flow	LB/MIN	EAC_EGR_Valve_High	%
CHL_EGR_Frac_Cmd	---	EAC_EGR_Valve_Low	%
CSE_MCF_Error	LB/MIN	EAC_Feedforward_Term	%
CSE_Xform_Error_1	---	EAC_Integral_Term	%
EGR_Valve_Delta_Press	IN_HG	EAC_Proportional_Term	%
		EAC_Preset	%
T_EGA_Cycle_Counter	CNTS	EAC_Preset_Lift	%
		Preset	---

60. EGR Valve Position Autozero

EGR_Position_Sensor	%open		
EGR_Position_Status	---		
EGR Valve Position AZ Enabler:			
T_EGR_Pos_AZ_Logic_Enable	---	EGA_PWM_Diagnostic_Override	---
EGA_Autozero_Enable	---	EGR_Valve_Autozero_Enabled	---
EGA_Zero_Hold_Status	---	EGR_Valve_Is_Closed	---
		EGA_Control_Error	---
EGR Position AZ Logic:			
C_EGR_Position_AZ_Tolerance	%open	EGR_Valve_Position_Offset	%open
C_EGR_Position_AZ_Enable_Time	SEC	EGR_Position_AP	%open
C_EGR_Position_AZ_Fault_Time	SEC	EGR_Position	%open
T_EGR_Clr_Autozero_Error_Count	---	EGR_Position_State	---
EGR_Valve_Autozero_Error	---	EGR_Position_Source	---

61. VG Turbocharger Duty Cycle Command

Filtered_Engine_Speed	RPM	TGC_VT_Cmd	%
TQM_Final_Torque_Cmd	FT*LB	VGT_Duty_Cycle	%DutyCycle
Total_Fueling	MG/STROKE	TGC_Adjusted_I_Gain	---
Fueling_Control_State	---	TGC_Adjusted_P_Gain	---
CBO_Charge_Aggressiveness_Ref	---	TGC_Error_Based_P_Gain	---
CSE_MCF_Error	LB/MIN	TGC_Feedforward_Term	%
CSE_Xform_Error_2	---	TGC_Integral_Term	%
EGR_Valve_Delta_Press	IN_HG	TGC_Proportional_Term	%
		TGC_Transient_Gain_Adj	---

62. VG Air Shutoff Valve Controls

Keyswitch	---	TB_Air_Shutoff_Valve_PWM_Duty_Cycle	%
Battery_Volt	VOLT	TB_Air_Shutoff_Valve_Pull_In_Duty_Cycle	%
TB_Air_Shutoff_Valve	---	TB_Air_Shutoff_Valve_Pull_In_Timer	SEC

Performance Diagnostics:

63. Charge Flow Derates [Charge Limit Manager (CHL)]

Filtered_Engine_Speed	RPM	Fueling_Control_State_Value	---
TQM_Final_Torque_Cmd	FT*LB	Charge_Press	IN_HG
Total_Fueling	MG/STROKE	Exhaust_Press	IN_HG

[CHL] Delta-P Derate Function:

EGR_Valve_Delta_Press	IN_HG	CHL_Derate_Is_Active	---
C_CHL_Delta_P_Drt_Limit	IN_HG	CHL_Delta_P_Drt_Active	---
C_CHL_Delta_P_Drt_Ratio	---	CHL_Delta_P_Drt_Offset	LB/MIN
Charge_Flow	LB/MIN	CHL_MCF_Cmd	LB/MIN
CHS_MCF_Cmd	LB/MIN	C_CHL_Delta_P_Drt_Fil_Cnst	---

[CHL] COT Derate Function:

Compressor_Outlet_Tmptr	DEG_F	CHL_Derate_Is_Active	---
C_CHL_COT_Drt_Limit	DEG_F	CHL_COT_Drt_Active	---
C_CHL_COT_Drt_Ratio	---	CHL_COT_Drt_Offset	LB/MIN
Charge_Flow	LB/MIN	CHL_MCF_Cmd	LB/MIN
CHS_MCF_Cmd	LB/MIN	C_CHL_COT_Drt_Fil_Cnst	---

[CHL] Turbo Speed Derate Function:

Compressor_Inlet_Density	LBM/FT3	CHL_Derate_Is_Active	---
Filtered_Turbo_Speed	KRPM	CHL_Turbo_Speed_Drt_Active	---
CHL_Turbo_Drt_Limit	KRPM	CHL_Turbo_Speed_Drt_Offset	LB/MIN
C_CHL_Turbo_Drt_Ratio	---	CHL_MCF_Cmd	LB/MIN
Charge_Flow	LB/MIN	C_CHL_Turbo_Drt_Fil_Cnst	---
CHS_MCF_Cmd	LB/MIN		

64. Oxygen / Fuel Control (OFC) Fuel Limit

Filtered_Engine_Speed	RPM	CBR_Fuel_Ref	MG/STROKE
TQM_Final_Torque_Cmd	FT*LB	CBR_FCLR_Ref	---
Total_Fueling	MG/STROKE	CBR_FCLR_On	---
Fueling_Control_State_Value	---	CBR_FCLR_Off	---
OFC_Fuel_Limit	MG/STROKE	OFC_EGR_Disable	---
CBR_Gross_Fuel	MG/STROKE		

65. Exhaust Temperature (Texh) Fuel Limit

Filtered_Engine_Speed	RPM	Texh_Fuel_Limit	MG/STROKE
TQM_Final_Torque_Cmd	FT*LB	Exhaust_Metal_Tmptr	DEG_F
Total_Fueling	MG/STROKE	CBR_Gross_Fuel	MG/STROKE
Fueling_Control_State_Value	---	CBR_Fuel_Ref	MG/STROKE

66. Chi Determination

Filtered_Engine_Speed	RPM	CBR_Chi_Value	---
TQM_Final_Torque_Cmd	FT*LB	CBR_Chi_Desired	---
Total_Fueling	MG/STROKE	CBR_Chi_Source	---
Fueling_Control_State_Value	---	CBR_Alpha	---
Compressor_Inlet_Density	LBM/FT3	CBR_Protection_Chi_Flag	---
Coolant_Tmptr	DEG_F	T_CBR_Chi_Selective_Override	ENABLE / DISABLE
Alpha	---	C_CBR_Chi_Override_LowTable	---
EMM_Cap_EL_Cmd	---	C_CBR_Chi_Override_HighTable	
EMM_Protection_State	---	T_CBR_Chi_User_Override	ENABLE / DISABLE
CBR_EGR_Off	---	C_CBR_Chi_Override_Value	

67. Altitude Performance

Filtered_Engine_Speed	RPM	CHL_MCF_Cmd	LB/MIN
Total_Fueling	MG/STROKE	Charge_Flow	LB/MIN
Fueling_Control_State_Value	---	CHL_EGR_Frac_Cmd	---
Final_Timing	CRANK_DEG	EGR_Fraction	---
Ambient_Air_Press	IN_HG	EGR_Position	%open
Ambient_Air_Tmptr	IN_HG	VGT_Duty_Cycle	%DutyCycle
Compressor_Inlet_Density	LBM/FT3	Compressor_Outlet_Tmptr	DEG_F
CBR_Chi_Value	---	Compressor_Inlet_Tmptr	DEG_F
Altitude	FT	Compressor_Inlet_Press	IN_HG
EGR_Valve_Delta_Press	IN_HG	Charge_Press	IN_HG
Exhaust_Tmptr	DEG_F	Charge_Tmptr	DEG_F
Exhaust_Metal_Tmptr	DEG_F	Exhaust_Press	IN_HG
Ndot_Net_Torque_Cmd	FT*LB	Filtered_Turbo_Speed	KRPM
Altitude_Derate_Torque	FT*LB	EMM_AECD_State	---
CBR_Density_Max_Fuel	MG/STROKE	EMM_Protection_State	---

68. EGR On Conditions

Filtered_Engine_Speed	RPM	Compressor_Outlet_Tmptr	DEG_F
TQM_Final_Torque_Cmd	FT*LB	Filtered_Turbo_Speed	KRPM
Total_Fueling	MG/STROKE	EGR_Position	%open
Fueling_Control_State_Value	---	EGA_Control_State	---
CBR_Chi_Value	---	EGR_Valve_Delta_Press	IN_HG
CBR_Chi_Source	---	EGR_Orifice_Delta_Press	IN_HG
CBR_Alpha	---	CHL_EGR_Frac_Cmd	---
Charge_Press	IN_HG	EGR_Fraction	---
Charge_Tmptr	DEG_F	CHL_MCF_Cmd	LB/MIN
Coolant_Tmptr	DEG_F	Charge_Flow	LB/MIN

69. EGR Off Conditions

Filtered_Engine_Speed	RPM	EGR_Position	%open
TQM_Final_Torque_Cmd	FT*LB	EGA_Control_State	---
Total_Fueling	MG/STROKE	EGR_Valve_Delta_Press	IN_HG
Fueling_Control_State_Value	---	EGR_Orifice_Delta_Press	IN_HG
CBR_Chi_Value	---	EGR_Valve_Is_Closed	---
CBR_Chi_Source	---	CHL_EGR_Frac_Cmd	---
CBR_Alpha	---	EMM_AECD_State	---
CBR_EGR_Off	---	EMM_Protection_State	---
EGR_Orifice_Tmptr	DEG_F	CHH_EGRT_Over_Temperature	---

70. EGR Valve Controller

Filtered_Engine_Speed	RPM	CHL_MCF_Cmd	LB/MIN
Total_Fueling	MG/STROKE	Charge_Flow	LB/MIN
Fueling_Control_State_Value	---	CSE_Xform_Error_1	---
EGR_Position	%open	CSE_Xform_Angle	DEG
EAC_EGR_Valve_Cmd	%open	EGR_Valve_Is_Closed	---
EGA_Control_State	---	EGR_Valve_Delta_Press	IN_HG
CHL_EGR_Frac_Cmd	---	Charge_Tmptr	DEG_F
EGR_Fraction	---	T_EGA_Cycle_Counter	CNTS

71. VGT Pneumatic Controller

Filtered_Engine_Speed	RPM	CHL_EGR_Frac_Cmd	---
Total_Fueling	MG/STROKE	EGR_Fraction	---
Fueling_Control_State_Value	---	CHL_MCF_Cmd	LB/MIN
VGT_Duty_Cycle	%DutyCycle	Charge_Flow	LB/MIN
TGC_VT_Cmd	%	CSE_Xform_Error_2	---
Charge_Press	IN_HG	CSE_Xform_Angle	DEG
Filtered_Turbo_Speed	KRPM		

72. EGR Motor Diagnostics

Filtered_Engine_Speed	RPM	EGA_Control_Error	---
TQM_Final_Torque_Cmd	FT*LB	EGA_Electrical_Fault	---
Total_Fueling	MG/SSTROKE	EGA_Over_Temperature	---
Fueling_Control_State_Value	---	EGA_Driver_Over_Current	---
EGR_Position	%open	EGA_Motor_OK	---
EAC_EGR_Valve_Cmd	%open	EGA_Zero_Hold_Status	---
EGA_Position_Cmd_Final	%open	EGR_Valve_Autozero_Error	---
EGA_Control_State	---	EGA_PWM_Enable	---
EGR_Valve_Delta_Press	IN_HG	EGA_PWM_Diagnostic_Override	---
EGR_Orifice_Delta_Press	IN_HG	EGA_PWM_Limited	%DUTY_CYCLE
EGR_Fraction	---	EGR_Motor_Current	AMP
CHL_EGR_Frac_Cmd	---	EGA_Temperature	DEG_F
T_EGA_Cycle_Counter	CNTS		

73. EGR Delta P Sensor Diagnostics

Filtered_Engine_Speed	RPM	EGR_Delta_P_Sensor	IN_HG
TQM_Final_Torque_Cmd	FT*LB	EGR_Delta_P_Sensor_Raw	CNTS
CBR_Fuel_Ref	MG/STROKE	EGR_Delta_Press_Sensor	IN_HG
Total_Fueling	MG/STROKE	EGR_Delta_Press_Status	---
Fueling_Control_State_Value	---	EGR_Delta_P_Sensor_High_Error	---
Charge_Press	IN_HG	EGR_Delta_P_Sensor_Low_Error	---
Exhaust_Press	IN_HG	EGR_Orifice_Delta_Press	IN_HG
Charge_Tmptr	DEG_F	EGR_Valve_Delta_Press	IN_HG
EGR_Delta_P_Sensor_Override	---	EGR_Delta_P_Autozero_Error	---
EGR_Delta_P_Sensor_User_Value	IN_HG		

EGR Delta P In-Range Rationality Diagnostics:

Filtered_Engine_Speed	RPM	EGR_DP_IR_Open_Error	---
Net_Engine_Torque	FT*LB	EGR_DP_IR_Open_Enable_Cond	---
EGR_Position	%open	EGR_DP_IR_Open_Fault_Cond	---
Engine_Delta_Press	IN_HG	EGR_DP_IR_Open_Fault_Cnt	CNTS
EGR_Delta_Press_AP	IN_HG	EGR_DP_IR_Closed_Error	---
EGR_Delta_Press_State	---	EGR_DP_IR_Closed_Enable_Cond	---
EGR_Delta_Press_Keyon_Error	---	EGR_DP_IR_Closed_Fault_Cond	---
T_EGR_DP_IR_Enable	HEX	EGR_DP_IR_Closed_Fault_Cnt	CNTS
EGR_Delta_Press	IN_HG		
EGR_Delta_Press_Source	---	EGR_DP_IR_Error	---

EGR Delta P Key-On Pressure Check:

Engine_State	---	EGR_Delta_Press_Check_Enable	---
EGR_Position	%open	EGR_Delta_Press_Check_Timer	SEC
EGR_Position_Status	---	EGR_Delta_Press_Keyon_Error	---
EGR_Delta_Press	IN_HG	EGR_DP_IR_Open_Error	---
EGR_Delta_Press_Status	---	EGR_DP_IR_Closed_Error	---
EGR_Delta_P_Autozero_Error	---	T_EGR_DP_IR_Startup_Enable	HEX

74. Torque Manager Derates

Filtered_Engine_Speed	RPM	Ndot_Net_Torque_Cmd	FT*LB
TQM_Final_Torque_Cmd	FT*LB	TQM_Machine_Torque_Limit	FT*LB
Net_Engine_Torque	FT*LB	TQM_Net_Machine_Torque_Cmd	FT*LB
Total_Fueling	MG/STROKE	TQM_Net_Engine_Torque_Rqst	FT*LB
Fueling_Control_State_Value	---	TQM_Engine_Torque_Limit	FT*LB
Torque_Derate_Override_Enable	---		
C_TQM_No_Derate_Torque	FT*LB		

ETIF Performance Evaluation:

75. EGR Valve and VGT Behavior

Filtered_Engine_Speed	RPM	Filtered_Turbo_Speed	KRPM
Total_Fueling	MG/STROKE	Charge_Press	IN_HG
Net_Engine_Torque	FT*LB	Exhaust_Press	IN_HG
Fueling_Control_State_Value	---	EGR_Delta_Press	IN_HG
Road_Speed	MPH	EGR_Valve_Delta_Press	IN_HG
CHL_EGR_Frac_Cmd	---	OFC_Fuel_Limit	MG/STROKE
EGR_Fraction	---	CBR_FCLR_Off	---
CHL_MCF_Cmd	LB/MIN	CBR_FCLR_On	---
Charge_Flow	LB/MIN	Alpha	---
EGR_Position	%open	CBR_Chi_Value	---
VGT_Duty_Cycle	%DutyCycle	CSE_Xform_Angle	DEG
Compressor_Inlet_Density	LBM/FT3	Ambient_Air_Press	IN_HG
T_EGA_Cycle_Counter	CNTS		

76. Engine Brake Performance

Filtered_Engine_Speed	RPM	EB_Active_Driver_Fraction	---
Filtered_Turbo_Speed	MG/STROKE	E_Brake_Command_Source	---
Commanded_Throttle	%THROTTLE	EB_Charge_Flow_Command	LB/MIN
Road_Speed	MPH	CHL_MCF_Cmd	LB/MIN
EB_Switch_Command	---	Charge_Flow	LB/MIN
EB_Switch_Torque	FT*LB	Charge_Press	IN_HG
EB_Adj_Torque_Command	FT*LB	Exhaust_Press	IN_HG
EB_Driver_Level	%	Ambient_Air_Press	IN_HG
Engine_Brake_Driver_1	---	Compressor_Inlet_Density	LBM/FT3
Engine_Brake_Driver_2	---	EGR_Position	%open
Engine_Brake_Driver_3	---	VGT_Duty_Cycle	%DutyCycle

77. Clutch Engagement Performance

LEVEL GROUND / GRADE:

Filtered_Engine_Speed	RPM	Ndot_Proportional_Gain	LBF/RPM/SEC
Ndot_Net_Torque_Cmd	FT*LB	Ndot_Integral_Gain	---
TQM_Final_Torque_Cmd	FT*LB	LSG_Reference_Speed	RPM
Total_Fueling	MG/STROKE	HSG_Active_Breakpoint	RPM
Fueling_Control_State_Value	---	CHL_EGR_Frac_Cmd	---
Commanded_Throttle	%THROTTLE	EGR_Fraction	---
Effective_Gear_Ratio	---	CHL_MCF_Cmd	LB/MIN
Filtered_Gear_Ratio	---	Charge_Flow	LB/MIN
Road_Speed	MPH	EGR_Valve_Position	%open
Ndot_LSG	RPM/SEC	VGT_Duty_Cycle	%DutyCycle
Ndot_HSG	RPM/SEC	System_Switch_Status	---
Ndot_Demand	RPM/SEC	System_Switch_Status_2	---

78. Engine Lug Up / Lug Down

Filtered_Engine_Speed	RPM	Charge_Press	IN_HG
Total_Fueling	MG/STROKE	Charge_Tmptr	DEG_F
TQM_Final_Torque_Cmd	FT*LB	Ambient_Air_Press	IN_HG
Fueling_Control_State_Value	---	EGR_Valve_Delta_Press	IN_HG
Commanded_Throttle	%THROTTLE	EGR_Delta_Press	IN_HG
Road_Speed	MPH	OFC_Fuel_Limit	MG/STROKE
CHL_EGR_Frac_Cmd	---	Alpha	---
EGR_Fraction	---	CBR_Chi_Value	---
CHL_MCF_Cmd	LB/MIN	CBR_FCLR_Off	---
CHS_MCF_Cmd	LB/MIN	CBR_FCLR_On	---
Charge_Flow	LB/MIN	CBR_FCLR_Ref	---
EGR_Position	%open	CHL_Delta_P_Drt_Active	---
VGT_Duty_Cycle	%DutyCycle	CHL_COT_Drt_Active	---
Filtered_Turbo_Speed	KRPM	CHL_Turbo_Speed_Drt_Active	---

79. Torque Response

Filtered_Engine_Speed	RPM	Road_Speed	MPH
TQM_Final_Torque_Cmd	FT*LB	Charge_Press	IN_HG
TQM_Net_Machine_Torque_Cmd	FT*LB	Filtered_Turbo_Speed	KRPM
Total_Fueling	MG/STROKE	VGT_Duty_Cycle	%DutyCycle
CBR_Gross_Fuel	MG/STROKE	Charge_Flow	LB/MIN
Fueling_Control_State_Value	---	CHL_MCF_Cmd	LB/MIN
Commanded_Throttle	%THROTTLE	Compressor_Outlet_Tmptr	DEG_F
Alpha	---	EGR _Position	%open
CBR_Chi_Value	---	EGR_Valve_Delta_Press	IN_HG
Ambient_Air_Press	IN_HG	EGR_Delta_Press	IN_HG

80. Coupled Controller Performance During Gear Shifts

Filtered_Engine_Speed	RPM	Alpha	---
Total_Fueling	MG/STROKE	CBR_Chi_Value	---
Fueling_Control_State_Value	---	CBL_EGR_Frac_Cmd	---
Commanded_Throttle	%THROTTLE	CHL_EGR_Frac_Cmd	---
Filtered_Gear_Ratio	---	EGR_Fraction	---
Road_Speed	MPH	CHS_MCF_Cmd	LB/MIN
Charge_Press	IN_HG	CHL_MCF_Cmd	LB/MIN
EGR_Valve_Delta_Press	IN_HG	Charge_Flow	LB/MIN
OFC_Fuel_Limit	MG/STROKE	CSE_Xform_Angle	DEG
Ambient_Air_Press	IN_HG	CSE_Xform_Error_1	---
Compressor_Inlet_Tmptr	DEG_F	CSE_Xform_Error_2	---
Compressor_Inlet_Density	LBM/FT3	EGR_Position	%open
Compressor_Outlet_Tmptr	DEG_F	VGT_Duty_Cycle	%DutyCycle
Net_Machine_Torque	FT*LB	Filtered_Turbo_Speed	KRPM
TQM_Final_Torque_Cmd	FT*LB		

81. Coolant and IMT Advance Control

Filtered_Engine_Speed	RPM	Sampled_Throttle_Raw	CNTS
Total_Fueling	MG/STROKE	Charge_Tmptr	DEG_F
Fueling_Control_State_Value	---	Coolant_Tmptr	DEG_F
Final_Timing	CRANK_DEG	Ambient_Air_Tmptr	DEG_F
Final_Timing_State	---	Ambient_Air_Press	IN_HG
CBR_SOI_Ref	CRANK_DEG	T_EGR_Delta_P_Autozero_Offset	IN_HG
Coolant_SOI_Advance	CRANK_DEG		
IMT_SOI_Advance	CRANK_DEG		

82. PTO Response

COLD ENGINE / WARM ENGINE:

Filtered_Engine_Speed	RPM	CHL_EGR_Frac_Cmd	---
Total_Fueling	MG/STROKE	EGR_Fraction	---
Fueling_Control_State_Value	---	CHL_MCF_Cmd	LB/MIN
FTT_ti_BaseFlTTL_v	MSEC	Charge_Flow	LB/MIN
PTO_Requested_Speed	RPM	EGR_Position	%open
PTO_State	---	VGT_Duty_Cycle	%DutyCycle
PTO_Status	---	Boost_Pressure	IN_HG
HSG_Active_Breakpoint	RPM	System_Switch_Status	---
LSG_Reference_Speed	RPM	Charge_Tmptr	DEG_F
PTO_Maximum_Reference_Speed	RPM	Coolant_Tmptr	DEG_F
		Oil_Tmptr	DEG_F

83. Snap Throttle Response (HSG/LSG Stationary)

Filtered_Engine_Speed	RPM	Boost_Pressure	IN_HG
Total_Fueling	MG/STROKE	OFC_Fuel_Limit	MG/STROKE
Fueling_Control_State_Value	---	EGR_Valve_Delta_Press	IN_HG
Commanded_Throttle	%THROTTLE	CSE_Xform_Angle	DEG
Sampled_Throttle_Raw	CNTS	User_Selected_Throttle_Control	---
HSG_Active_Breakpoint	RPM	Oil_Tmptr	DEG_F
CHL_EGR_Frac_Cmd	---	Charge_Tmptr	DEG_F
EGR_Fraction	---	Ambient_Air_Press	IN_HG
CHL_MCF_Cmd	LB/MIN	CBR_FCLR_Off	---
Charge_Flow	LB/MIN	CBR_FCLR_On	---
EGR_Position	%open	T_EGR_Delta_P_Autozero_Offset	IN_HG
VGT_Duty_Cycle	%DutyCycle		

84. Engine Start-Up

COLD ENGINE START-UP:		*WARM ENGINE START-UP:*	
Filtered_Engine_Speed	RPM	Filtered_Engine_Speed	RPM
Total_Fueling	MG/STROKE	Total_Fueling	MG/STROKE
Fueling_Control_State_Value	---	Fueling_Control_State	---
Final_Timing	CRANK_DEG	Final_Timing	CRANK_DEG
Final_Timing_State	---	Final_Timing_State	---
EPS_Main_Sync_State	---	Crank_Jumpstart_Timer	SEC
EPS_Backup_Sync_State	---	Fuel_Rail_Pressure	PSI_A
Fuel_Rail_Pressure	PSI_A	Charge_Tmptr	DEG_F
Battery_Volt	VOLT	Oil_Tmptr	DEG_F
Charge_Tmptr	DEG_F	Oil_Press	PSI
Oil_Tmptr	DEG_F	Coolant_Tmptr	DEG_F
Oil_Press	PSI	Ambient_Air_Press	IN_HG
Coolant_Tmptr	DEG_F	Ambient_Air_Tmptr	DEG_F
Ambient_Air_Press	IN_HG	LSG_Reference_Speed	RPM
Compressor_Inlet_Tmptr	DEG_F	Crank_Exit_Speed	RPM
LSG_Reference_Speed	RPM	Crank_Exit_Fuel	MG/STROKE
Crank_Exit_Speed	RPM	T_EGR_Delta_P_Autozero_Offset	IN_HG
Crank_Exit_Fuel	MG/STROKE	EGR_Fraction	---
T_EGR_Delta_P_Autozero_Offset	IN_HG	CHL_EGR_Frac_Cmd	---
		Charge_Flow	LB/MIN
		CHL_MCF_Cmd	LB/MIN
		EGR_Position	%open
		VGT_Duty_Cycle	%DutyCycle

85. Low Idle Stability, Stationary

Filtered_Engine_Speed	RPM	CHL_EGR_Frac_Cmd	---
Total_Fueling	MG/STROKE	EGR_Fraction	---
Fueling_Control_State_Value	---	CHL_MCF_Cmd	LB/MIN
FTT_ti_BaseFlTTL_v	MSEC	Charge_Flow	LB/MIN
LSG_Proportional_Gain	1/SEC	EGR_Position	%open
Ndot_LSG	RPM/SEC	VGT_Duty_Cycle	%DutyCycle
TQM_Net_Engine_Torque_Rqst	FT*LB	Alpha	---
Charge_Tmptr	DEG_F	T_EGR_Delta_P_Autozero_Offset	IN_HG
Coolant_Tmptr	DEG_F		

86. PTO Pump-Off

Filtered_Engine_Speed	RPM	PTO_State	---
Total_Fueling	MG/STROKE	PTO_Status	---
Fueling_Control_State_Value	---	Charge_Tmptr	DEG_F
FTT_ti_BaseFlTTL_V	MSEC	Coolant_Tmptr	DEG_F
PTO_Requested_Speed	---	Oil_Tmptr	DEG_F
HSG_Active_Breakpoint	RPM		

87. Throttle Characterization

Filtered_Engine_Speed	RPM	FTT_ti_BaseFlTTL_v	MSEC
Commanded_Throttle	%THROTTLE	CHL_EGR_Frac_Cmd	---
Sampled_Throttle_Raw	CNTS	EGR_Fraction	---
Throttle_Status	---	CHL_MCF_Cmd	LB/MIN
Total_Fueling	MG/STROKE	Charge_Flow	LB/MIN
Fueling_Control_State_Value	---	EGR_Position	%open
Sampled_Throttle	%	VGT_Duty_Cycle	%DutyCycle
Throttle_Min	%THROTTLE	Boost_Pressure	IN_HG
User_Selected_Throttle_Control	---		
Auto_Zero	%THROTTLE		
Throttle_Deadband	%THROTTLE		

88. Snap Throttle Response (HSG, Bobtail)

Filtered_Engine_Speed	RPM	CHL_EGR_Frac_Cmd	---
Total_Fueling	MG/STROKE	EGR_Fraction	---
Fueling_Control_State_Value	---	CHL_MCF_Cmd	LB/MIN
Final_Timing	CRANK_DEG	Charge_Flow	LB/MIN
Final_Timing_State	---	EGR_Position	%open
Commanded_Throttle	%THROTTLE	VGT_Duty_Cycle	%DutyCycle
Road_Speed	MPH	Filtered_Turbo_Speed	KRPM
HSG_Active_Breakpoint	RPM	Boost_Pressure	IN_HG
HSG_Reference_Speed	RPM	User_Selected_Throttle_Control	---
HSG_Breakpoint_Speed	RPM		

89. Throttle Control / Stability, Bobtail

Filtered_Engine_Speed	RPM	EGR_ Position	
Total_Fueling	MG/STROKE	VGT_Duty_Cycle	
Commanded_Throttle	%THROTTLE	Boost_Pressure	
Sampled_Throttle_Raw	CNTS	OFC_Fuel_Limit	
Road_Speed	MPH	EGR_Valve_Delta_Press	
Filtered_Gear_Ratio	---	CSE_Xform_Angle	
CHL_EGR_Frac_Cmd	---	CBR_FCLR_Off	---
EGR_Fraction	---	CBR_FCLR_On	---
CHL_MCF_Cmd	LB/MIN	User_Selected_Throttle_Control	---
Charge_Flow	LB/MIN		

90. Idle In Gear, Bobtail

Filtered_Engine_Speed	RPM	CHL_EGR_Frac_Cmd	---
Total_Fueling	MG/STROKE	EGR_Fraction	---
Road_Speed	MPH	CHL_MCF_Cmd	LB/MIN
Filtered_Gear_Ratio	---	Charge_Flow	LB/MIN
LSG_Proportional_Gain	1/SEC	EGR_ Position	%open
Ndot_LSG	RPM/SEC	VGT_Duty_Cycle	%DutyCycle
TQM_Net_Engine_Torque_Rqst	FT*LB		
Ndot_Net_Torque_Cmd	FT*LB		

91. Gear Ratio Validation

Filtered_Engine_Speed	RPM	Filtered_Gear_Ratio	---
Road_Speed	MPH	Effective_Gear_Ratio	---
User_Filtered_Gear_Ratio	---	RSC_Sensor_Type	---

92. Cruise Control Base Functionality

Filtered_Engine_Speed	RPM	CHL_MCF_Cmd	LB/MIN
Total_Fueling	MG/STROKE	Charge_Flow	LB/MIN
Fueling_Control_State_Value	---	EGR_Position	%open
Adjusted_User_Fueling_State	---	VGT_Duty_Cycle	%DutyCycle
Cruise_Control_Reference_Speed	MPH	Filtered_Turbo_Speed	KRPM
Road_Speed	MPH	Charge_Press	IN_HG
System_Switch_Status	---	Cruise_Max_Road_Speed_Trim	MPH
Cruise_Command_Mode	---	Cruise_Max_Road_Speed	MPH
CHL_EGR_Frac_Cmd	---	Cruise_Top_Droop_Width	MPH
EGR_Fraction	---	Cruise_Bottom_Droop_Width	MPH

93. Road Speed Governor Base Functionality

Filtered_Engine_Speed	RPM	CHL_MCF_Cmd	LB/MIN
Total_Fueling	MG/STROKE	Charge_Flow	LB/MIN
Fueling_Control_State_Value	---	VGT_Duty_Cycle	%DutyCycle
Adjusted_User_Fueling_State	---	Filtered_Turbo_Speed	KRPM
Commanded_Throttle	%THROTTLE	Charge_Press	IN_HG
RSG_Error	MPH	Max_Road_Speed_Trim	MPH
RSG_Droop	MPH	Max_Road_Speed	MPH
RSG_Reference_Speed	MPH	RSG_Top_Droop_Width	MPH
Road_Speed	MPH	RSG_Bottom_Droop_Width	MPH
CHL_EGR_Frac_Cmd	---	Top_Gear_Ratio	---
EGR_Fraction	---	Gear_Down_Gear_Ratio	---
		Gear_Down_Active	---

94. Cruise Control Auto Resume

Filtered_Engine_Speed	RPM	System_Switch_Status	---
Total_Fueling	MG/STROKE	Cruise_Command_Mode	---
Fueling_Control_State_Value	---	Cruise_Control_Status	---
Adjusted_User_Fueling_State	---	Filtered_Gear_Ratio	---
Cruise_Control_Reference_Speed	MPH	Max_Road_Speed	MPH
CC_Error	MPH	Cruise_Max_Road_Speed	MPH
Road_Speed	MPH	GD_Gear_Down_High_Load_Speed	MPH
Cruise_Control_AR_Flag	---	Cruise_Control_AR_Clutch_Time_Limit	MPH

95. Cruise Control with Engine Brakes

Filtered_Engine_Speed	RPM	EB_Charge_Flow_Command	LB/MIN
FSS_Total_Fueling	MG/STROKE	CHL_MCF_Cmd	LB/MIN
Fueling_Control_State_Value	---	Charge_Flow	LB/MIN
Cruise_Control_Reference_Speed	MPH	EB_Driver_Level	%
Road_Speed	MPH	EB_Active_Driver_Fraction	---
TQM_Final_Torque_Cmd	FT*LB	EB_Allowed_State	---
Net_Engine_Torque	FT*LB	EB_Brakes_Are_On	---
Cruise_Control_EB_Torque	FT*LB	EB_Cruise_Braking_Inhibit	---
EB_Adj_Torque_Cmd	FT*LB	VGT_Duty_Cycle	%DutyCycle

96. Cruise Control Overshoot

Filtered_Engine_Speed	RPM	Road_Speed	MPH
Total_Fueling	MG/STROKE	System_Switch_Status	---
Fueling_Control_State_Value	---	Cruise_Command_Mode	---
Adjusted_User_Fueling_State	---	Cruise_Control_Status	---
CC_Error	MPH	Ndot_Demand	RPM/SEC
Cruise_Droop	MPH	Ndot_Cruise_Control	RPM/SEC
Cruise_Control_Reference_Speed	MPH		

97. Road Speed Governor Overshoot

Filtered_Engine_Speed	RPM	RSG_Error	MPH
Total_Fueling	MG/STROKE	RSG_Droop	MPH
Fueling_Control_State_Value	---	Road_Speed	MPH
Adjusted_User_Fueling_State	---	RSG_Reference_Speed	MPH
Commanded_Throttle	%THROTTLE	Ndot_Demand	RPM/SEC
		Ndot_RSG	RPM/SEC

98. Reverse ESP / Take-Off ESP

Filtered_Engine_Speed	RPM	Reverse_ESP_Transition_Flag	---
Total_Fueling	MG/STROKE	Reverse_ESP_Min_Gear_Ratio	---
Fueling_Control_State_Value	---	Road_Speed	MPH
ESP_Tau	---	User_Filtered_Gear_Ratio	---
ESP_Tau_State	---	Commanded_Throttle	%THROTTLE
Reverse_ESP_Tau	---	System_Switch_Status	---

99. High Idle Stability, Loaded Trailer

Filtered_Engine_Speed	RPM	HSG_Proportional_Gain	%FUEL
Total_Fueling	MG/STROKE	Ndot_HSG	RPM/SEC
Fueling_Control_State_Value	---	Ndot_Net_Torque_Cmd	FT*LB
HSG_Reference_Speed	RPM	TQM_Final_Torque_Cmd	FT*LB
HSG_Ref_Speed_State	---	CHL_EGR_Frac_Cmd	---
Road_Speed	MPH	EGR_Fraction	---
Ndot_Feedforward_Torque	FT*LB	CHL_MCF_Cmd	LB/MIN
Ndot_Integral_Torque	FT*LB	Charge_Flow	LB/MIN

100. Throttle Control / Stability, Loaded Trailer

Filtered_Engine_Speed	RPM	EGR_Position	%open
Total_Fueling	MG/STROKE	VGT_Duty_Cycle	%DutyCycle
Commanded_Throttle	%THROTTLE	Charge_Press	IN_HG
Sampled_Throttle_Raw	CNTS	OFC_Fuel_Limit	MG/STROKE
Road_Speed	MPH	EGR_Valve_Delta_Press	IN_HG
Filtered_Gear_Ratio	---	CSE_Xform_Angle	DEG
CHL_EGR_Frac_Cmd	---	CHL_Delta_P_Drt_Active	---
EGR_Fraction	---	CHL_COT_Drt_Active	---
CHL_MCF_Cmd	LB/MIN	CHL_Turbo_Speed_Drt_Active	---
CHS_MCF_Cmd	LB/MIN	User_Selected_Throttle_Control	---
Charge_Flow	LB/MIN		

101. Idle In Gear, Loaded Trailer

Filtered_Engine_Speed	RPM	Fuel_Rail_Pressure	PSI_A
Total_Fueling	MG/STROKE	Ndot_Net_Torque_Cmd	FT*LB
Road_Speed	MPH	TQM_Net_Engine_Torque_Rqst	FT*LB
Filtered_Gear_Ratio	---	CHL_EGR_Frac_Cmd	---
LSG_Proportional_Gain	1/SEC	EGR_Fraction	---
Ndot_LSG	RPM/SEC	CHL_MCF_Cmd	LB/MIN
Ndot_Demand	RPM/SEC	Charge_Flow	LB/MIN
FTT_ti_BaseFlTTL_v	MSEC	EGR_Position	%open
FTT_ti_BaseTmTTL_v	MSEC	VGT_Duty_Cycle	%DutyCycle

102. Sensor Characterization

Filtered_Engine_Speed	RPM		
Coolant_Temperature_Raw	CNTS	Coolant_Tmptr	DEG_F
Oil_Temperature_Raw	CNTS	Oil_Tmptr	DEG_F
Oil_Pressure_Absolute_Raw	CNTS	Oil_Press_Absolute	PSI_A
Air_Pressure_Sensor_Raw	CNTS	Ambient_Air_Press	IN_HG
Compressor_Inlet_Temperature_Raw	CNTS	Compressor_Inlet_Tmptr	DEG_F
Boost_Pressure_Absolute_Raw	CNTS	Charge_Press	IN_HG
Intake_Manifold_Temperature_Sensor_Raw	CNTS	Charge_Tmptr	IN_HG
Exhaust_Pressure_Sensor_Raw	CNTS	Exhaust_Press	IN_HG
Battery_Voltage_Raw	CNTS	Battery_Volt	VOLT
Sampled_Throttle_Raw	CNTS	Sampled_Throttle	%
EGR_Delta_P_Sensor_Raw	CNTS	EGR_Delta_Press	IN_HG
EGR_Position_Before_Autozero_Raw	CNTS	EGR_Position	%open
EGR_Orifice_Temperature_Raw	CNTS	EGR_Orifice_Tmptr	DEG_F
Raw_Turbo_Speed	CNTS	Filtered_Turbo_Speed	KRPM
Fuel_Temperature_Raw	CNTS	Fuel_Tmptr	DEG_F
Fuel_Rail_Pressure_Raw	CNTS	Fuel_Rail_Press	PSI
Coolant_Level_Raw	CNTS	Coolant_Level	VOLT

103. Surge Characterization

Air Handling Controller Induced Surge:

Filtered_Engine_Speed	RPM	CHS_MCF_Cmd	LB/MIN
FSS_Total_Fueling	MG/STROKE	CHL_MCF_Cmd	LB/MIN
Fueling_Control_State_Value	---	Charge_Flow	LB/MIN
Filtered_Turbo_Speed	KRPM	CBL_EGR_Frac_Cmd	---
Compressor_Inlet_Tmptr	DEG_F	CHL_EGR_Frac_Cmd	---
Compressor_Outlet_Tmptr	DEG_F	EGR_Fraction	---
Charge_Tmptr	DEG_F	VGT_Duty_Cycle	%DutyCycle
Exhaust_Tmptr	DEG_F	TGC_VT_Cmd	%
Charge_Press	IN_HG	EGR_Position	%open
Compressor_Inlet_Press	IN_HG	EAC_EGR_Valve_Cmd	%open
Compressor_Inlet_Density	LBM/FT3	Fresh_Air_Flow	LB/MIN

Quasi-Steady State Compressor Surge:

Filtered_Engine_Speed	RPM	Compressor_Outlet_Tmptr	DEG_F
FSS_Total_Fueling	MG/STROKE	Compressor_Inlet_Density	LBM/FT3
Fueling_Control_State_Value	---	CBR_Chi_Value	---
Filtered_Turbo_Speed	KRPM	CBP_Air_Fuel_Ratio	---
Compressor_Inlet_Tmptr	DEG_F	CHP_Volumetric_Efficiency	---
Charge_Tmptr	DEG_F	EGR_Position	%open
CHL_EGR_Frac_Cmd	---	VGT_Duty_Cycle	%DutyCycle
EGR_Fraction	---		

Transient Compressor Surge:

Filtered_Engine_Speed	RPM	Boost_Pressure	IN_HG
FSS_Total_Fueling	MG/STROKE	Filtered_Turbo_Speed	KRPM
Fueling_Control_State_Value	---	Altitude	FT
Charge_Press	IN_HG	Charge_Flow	LB/MIN
Charge_Tmptr	DEG_F	CHS_MCF_Cmd	LB/MIN
Compressor_Inlet_Tmptr	DEG_F	CHL_MCF_Cmd	LB/MIN
Compressor_Inlet_Density	LBM/FT3	EGR_Position	%open
Compressor_Outlet_Tmptr	DEG_F	VGT_Duty_Cycle	%DutyCycle

Engine Surge:

Filtered_Engine_Speed	RPM	Effective_Gear_Ratio	---
FSS_Total_Fueling	MG/STROKE	Ndot_LSG	RPM/SEC
Fueling_Control_State_Value	---	Ndot_HSG	RPM/SEC
TQM_Final_Torque_Cmd	FT*LB	Ndot_Four_D	RPM/SEC
Ndot_Net_Torque_Cmd	FT*LB	Ndot_Cruise_Control	RPM/SEC
No_Load_Torque	FT*LB	Ndot_RSG	RPM/SEC
Ndot_Demand	RPM/SEC	Ndot_ASG	RPM/SEC
Ndot_Actual	RPM/SEC	Ndot_PTO	RPM/SEC

104. OFC and Texh Fuel Limits

Filtered_Engine_Speed	RPM	CBR_FCLR_On	---
FSS_Total_Fueling	MG/STROKE	CBR_FCLR_Off	---
Fueling_Control_State_Value	---	CBR_FCLR_Ref	---
OFC_Fuel_Limit	MG/STROKE	CBR_EGR_Disabled	---
Texh_Fuel_Limit	MG/STROKE	EGR_Position	%open
CBR_Fuel_Ref	MG/STROKE		
CBR_Gross_Fuel	MG/STROKE		

105. Dyno Performance Monitor

Filtered_Engine_Speed	RPM	Commanded_Throttle	%THROTTLE
FSS_Total_Fueling	MG/STROKE	Alpha	---
Net_Engine_Torque	FT*LB	CBR_Chi_Value	---
No_Load_Torque	FT*LB	Coolant_Tmptr	DEG_F
Fueling_Control_State_Value	---	Compressor_Inlet_Tmptr	DEG_F
Final_Timing	CRANK_DEG	Charge_Tmptr	DEG_F
EGR_Position	%open	Charge_Press	IN_HG
VGT_Duty_Cycle	%DutyCycle	Exhaust_Press	IN_HG
Filtered_Turbo_Speed	KRPM	Compressor_Outlet_Tmptr	DEG_F
EGR_Fraction	---	Compressor_Inlet_Density	LBM/FT3
CHL_EGR_Frac_Cmd	---	Exhaust_Tmptr	DEG_F
Charge_Flow	LB/MIN	Ambient_Air_Press	IN_HG
CHL_MCF_Cmd	LB/MIN	Ambient_Air_Tmptr	DEG_F
EGR_Valve_Delta_Press	IN_HG	Fuel_Rail_Press	PSI
EGR_Delta_Press	IN_HG	EMM_AECD_State	---
EGR_Orifice_Tmptr	DEG_F	EMM_Protection_State	---
Fresh_Air_Flow	LB/MIN	Fuel_Tmptr	DEG_F
CBO_bsNOx	G/HP*HR	ESP_Tau	---
System_Switch_Status	HEX	Oil_Press	PSI
System_Switch_Status_2	HEX	Oil_Tmptr	DEG_F

Application Features:

106. NDOT Governor

Filtered_Engine_Speed	RPM	Commanded_Throttle	%THROTTLE
Ndot_Net_Torque_Cmd	FT*LB	Road_Speed	MPH
Ndot_Net_Torque_Cmd_State	---	Effective_Gear_Ratio	---
Ndot_Integral_Torque	FT*LB	Ndot_Demand	RPM/SEC
Ndot_Proportional_Torque	FT*LB	Ndot_Actual	RPM/SEC
Ndot_Feedforward_Torque	FT*LB	Ndot_Error	RPM/SEC
Ndot_Excess_Machine_Torque	FT*LB	Torque_Derived_Ndot	---
Ndot_Excess_Torque_Adj	FT*LB		
No_Load_Torque	FT*LB	Ndot_Integral_Gain	---
Net_Machine_Torque	FT*LB	Ndot_Proportional_Gain	---
		Ndot_Feedforward_Gain	---

107. All Speed Governor (ASG)

Filtered_Engine_Speed	RPM	Ndot_User_Command	RPM/SEC
Total_Fueling	MG/STROKE	Ndot_ASG	RPM/SEC
Fueling_Control_State	---	Ndot_Demand	RPM/SEC
Commanded_Throttle	%THROTTLE	Ndot_Error	RPM/SEC
Road_Speed	MPH	Net_Engine_Torque	FT*LB
Effective_Gear_Ratio	---	Ndot_Net_Torque_Cmd	FT*LB
ASG_Reference_Speed	RPM	Ndot_Net_Torque_Cmd_State	---
Torque_Derived_Ndot	---	Ndot_Integral_Torque	FT*LB

108. High Idle Governor (HSG)

Filtered_Engine_Speed	RPM	HSG_Reference_Speed	RPM
Total_Fueling	MG/STROKE	Ndot_HSG	RPM/SEC
Fueling_Control_State	---	Ndot_Demand	RPM/SEC
Net_Engine_Torque	FT*LB	Ndot_Error	RPM/SEC
Ndot_Net_Torque_Cmd	FT*LB	Commanded_Throttle	%THROTTLE
Ndot_Net_Torque_Cmd_State	---	Road_Speed	MPH
Ndot_Integral_Torque	FT*LB	Effective_Gear_Ratio	---

109. Low Idle Governor (LSG)

Filtered_Engine_Speed	RPM	LSG_Reference_Speed	RPM
Total_Fueling	MG/STROKE	Ndot_LSG	RPM/SEC
Fueling_Control_State	---	Ndot_Demand	RPM/SEC
Net_Engine_Torque	FT*LB	Ndot_Error	RPM/SEC
Ndot_Net_Torque_Cmd	FT*LB	Commanded_Throttle	%THROTTLE
Ndot_Net_Torque_Cmd_State	---	Road_Speed	MPH
Ndot_Integral_Torque	FT*LB	Effective_Gear_Ratio	---

110. Throttle Governor (Min/Max)

Filtered_Engine_Speed	RPM	Torque_Derived_Ndot	---
Total_Fueling	MG/STROKE	Ndot_Four_D	RPM/SEC
Fueling_Control_State	---	Ndot_Demand	RPM/SEC
Net_Engine_Torque	FT*LB	Ndot_Error	RPM/SEC
Ndot_Net_Torque_Cmd	FT*LB	Four_D_Torque	FT*LB
Ndot_Net_Torque_Cmd_State	---	Alpha	---
Commanded_Throttle	%THROTTLE	Road_Speed	MPH
Ndot_Integral_Torque	FT*LB	Effective_Gear_Ratio	---

111. Power Take-Off Governor (PTO)

Filtered_Engine_Speed	RPM	PTO_Reference_Speed	RPM
Total_Fueling	MG/STROKE	Ndot_PTO	RPM/SEC
Fueling_Control_State	---	Ndot_Demand	RPM/SEC
Net_Engine_Torque	FT*LB	Ndot_Error	RPM/SEC
Ndot_Net_Torque_Cmd	FT*LB	Ndot_User_Command	RPM/SEC
Ndot_Net_Torque_Cmd_State	---	System_Switch_Status	HEX
Ndot_Integral_Torque	FT*LB	System_Switch_Status_2	HEX
PTO_Status	---		

112. Road Speed Governor (RSG)

Filtered_Engine_Speed	RPM	Road_Speed	MPH
Total_Fueling	MG/STROKE	Max_Road_Speed	MPH
Fueling_Control_State	---	RSG_Reference_Speed	MPH
Net_Engine_Torque	FT*LB	Ndot_RSG	RPM/SEC
Ndot_Net_Torque_Cmd	FT*LB	Ndot_Demand	RPM/SEC
Ndot_Net_Torque_Cmd_State	---	Ndot_Error	RPM/SEC
Ndot_Integral_Torque	FT*LB	Commanded_Throttle	%THROTTLE
Effective_Gear_Ratio	---	System_Switch_Status	HEX

113. Cruise Control Governor (CC)

Filtered_Engine_Speed	RPM	Road_Speed	MPH
Total_Fueling	MG/STROKE	Cruise_Max_Road_Speed	MPH
Fueling_Control_State	---	Cruise_Control_Reference_Speed	MPH
Net_Engine_Torque	FT*LB	Ndot_Cruise_Control	RPM/SEC
Ndot_Net_Torque_Cmd	FT*LB	Ndot_Demand	RPM/SEC
Ndot_Net_Torque_Cmd_State	---	Ndot_Error	RPM/SEC
Ndot_Integral_Torque	FT*LB	Cruise_Control_Status	---
Effective_Gear_Ratio	---	System_Switch_Status	---
Commanded_Throttle	%THROTTLE		

114. SOI Timing Control

Filtered_Engine_Speed	RPM	CBO_SOI_Ref	CRANK_DEG
Total_Fueling	MG/STROKE	SOI_Timing_Advance	CRANK_DEG
Fueling_Control_State	---	Misfire_SOI	CRANK_DEG
Final_Timing	CRANK_DEG	ANC_SOI	CRANK_DEG
Final_Timing_State	---	CBL_SOI_Cmd	CRANK_DEG
CBR_Alpha	---	EB_Timing	CRANK_DEG
CBR_Chi_Value	---	CBM_SOI	CRANK_DEG
CBR_Fuel_Ref	MG/STROKE	CBA_SOI_State	---
CBR_SOI_Ref	CRANK_DEG	T_CBL_SOI_Increment_Enable	ENABLE / DISABLE
		C_CBL_SOI_Increment	CRANK_DEG

115. SOI Timing Control – SOI Advance

Filtered_Engine_Speed	RPM	CBO_SOI_Ref	CRANK_DEG
Total_Fueling	MG/STROKE	IMT_SOI_Advance	CRANK_DEG
Fueling_Control_State	---	Coolant_SOI_Advance	CRANK_DEG
Final_Timing	CRANK_DEG	Ambient_Pressure_SOI_Advance	CRANK_DEG
Final_Timing_State	---	SOI_Timing_Advance	CRANK_DEG
Charge_Tmptr	DEG_F	SOI_State	---
Coolant_Tmptr	DEG_F	CBA_SOI_State	---
Ambient_Air_Press	IN_HG		

116. Engine Start-Up / Cranking

Filtered_Engine_Speed	RPM	EPS_Main_Sync_State	---
Total_Fueling	MG/STROKE	EPS_Backup_Sync_State	---
Fueling_Control_State	---	Crank_Exit_Speed	RPM
TQM_Final_Torque_Cmd	FT*LB	Crank_Fuel	MG/STROKE
No_Load_Torque	FT*LB	Crank_Exit_Fuel_Adjustment	MG/STROKE
Coolant_Tmptr	DEG_F	Crank_Advance	CRANK_DEG
Ambient_Air_Tmptr	DEG_F	Crank_Exit_Timer	SEC
Charge_Tmptr	DEG_F	Crank_Reentry_Speed	RPM
		Crank_Jumpstart_Timer	SEC

117. Engine Brake Manager

Filtered_Engine_Speed	RPM	EB_Cruise_Engine_Brake_Active	---
Total_Fueling	MG/STROKE	EB_CC_Brake_Torque_Only	---
Fueling_Control_State	---	Cruise_Control_EB_Torque	FT*LB
TQM_Final_Torque_Cmd	FT*LB	EB_Switch_Torque	FT*LB
Charge_Flow	LB/MIN	EB_Override_Torque	FT*LB
CHL_MCF_Cmd	LB/MIN	EB_Jcomm_Non_Override_Torque	FT*LB
Exhaust_Press	IN_HG	EB_Torque_Command	FT*LB
Charge_Press	IN_HG	EB_Charge_Flow_Command	LB/MIN
E_Brake_Status	---		
Engine_Brake_Inhibit	---	Engine_Brake_Driver_1	---
EB_Allowed_State	---	Engine_Brake_Driver_2	---
EB_Immediate_Brake	---	Engine_Brake_Driver_3	---

118. Engine Fan Control

Filtered_Engine_Speed	RPM	Fan_Torque	FT*LB
Engine_State	---	Fan_Clutch_1_PWM_Duty_Cycle	%
Total_Fueling	MG/STROKE	Fan_Clutch_1_PWM_Period	USEC
TQM_Final_Torque_Cmd	FT*LB	Fan_Air_Conditioner_Request	%
Fueling_Control_State	---	Fan_Coolant_Temp_Request	%
Coolant_Tmptr	DEG_F	Fan_Datalink_Request	%
Intake_Manifold_Temperature	DEG_F	Fan_Engine_Brake_Request	%
Air_Conditioner_Pressure_Switch	---	Fan_Intake_Manifold_Temp_Request	%
EB_Driver_Level	---	Fan_Manual_Input_Request	%
Manual_Fan_Input	---	Fan_Tool_Request	%
Fan_Request	%	Manual_Fan_Level	%
Fan_Drive_State	---	Fan_Clutch_Logic	---

119. Alpha Determination

Filtered_Engine_Speed	RPM	Alpha	---
Total_Fueling	MG/STROKE	ESP_Tau	---
Fueling_Control_State	---	Alpha_State	---
TQM_Final_Torque_Cmd	FT*LB		
Road_Speed	MPH	Ambient_Air_Press	IN_HG
OFC_Fuel_Limit	MG/STROKE	Alpha_AFC_Timer	SEC
OFC_EGR_Disable	---	Alpha_LSG_Timer	SEC
Filtered_Fuel_Delivery_Rate	LB/HR	Cruise_Control_Status	---
Fuel_Delivery_Rate	LB/HR	EPF_Torque_Limit_Status	---
Alpha_Fuel_Rate	LB/HR	LSG_Adjusted_Reference_Speed	RPM

120. Noise Control – Speed Derates

Filtered_Engine_Speed	RPM	Ndot_Demand	RPM/SEC
Total_Fueling	MG/STROKE	Ndot_Four_D	RPM/SEC
Fueling_Control_State	---	Ndot_ASG	RPM/SEC
TQM_Final_Torque_Cmd	FT*LB	Ndot_ANC	RPM/SEC
Effective_Gear_Ratio	---	Ndot_HSG	RPM/SEC
Road_Speed	MPH	Ndot_Error	RPM/SEC

121. Smart Torque (ST Rating)

Filtered_Engine_Speed	RPM	ESP_Tau	---
Total_Fueling	MG/STROKE	ESP_Tau_State	---
Fueling_Control_State	---	Smart_Torque_Gear_Ratio	---
TQM_Final_Torque_Cmd	FT*LB	ESP_Smart_Torque_Enable	ENABLE/DISABLE
Filtered_Gear_Ratio	---	Four_D_Torque	FT*LB
Coolant_Tmptr	DEG_F	ESP_Filtered_Engine_Decel_Rate	RPM/SEC
Charge_Tmptr	DEG_F	Steady_State_Torque_Min	FT*LB
Ndot_Integral_Torque	FT*LB	Steady_State_Torque_Max	FT*LB
Net_Machine_Torque	FT*LB	Transient_Torque_Min	FT*LB
Throttle_100_Torque	FT*LB	Transient_Torque_Max	FT*LB
ESP_Steep_Grade_Transition_Flag	---	Torque_Interp_Factor	---
Reverse_ESP_Transition_Flag	---	Road_Speed	MPH
Brake_Switch	---	Commanded_Throttle	%THROTTLE

122. Load Based Speed Controls (LBSC)

[SM] Shift Manager:

Filtered_Engine_Speed	RPM	Filtered_Gear_Ratio	---
FSS_Total_Fueling	MG/STROKE	Gear_Down_Gear_Ratio	---
Fueling_Control_State_Value	---	SM_Engine_Torque	FT*LB
TQM_Final_Torque_Cmd	FT*LB	SM_Torque_Threshold	FT*LB
HSG_Active_Isochronous_Speed	RPM	SM_Downshifft_Active	---
HSG_Active_Isochronous_Speed_State	---	SM_Reference_Speed	RPM
HSG_Active_Breakpoint	RPM	SM_Ref_Speed_Adjust	RPM
HSG_Reference_Speed	RPM	SM_Ref_Mode	---
Vehicle Trims:			
T_Shift_Manager_Enable	HEX	RSC_Sensor_Type	---
T_SM_High_RPM_Breakpoint	RPM	VSS_Transmission	---
T_SM_Low_RPM_Breakpoint	RPM		
Commanded_Throttle	%THROTTLE	Net_Machine_Torque	FT*LB
Road_Speed	MPH	Throttle_100_Torque	FT*LB
Top_Gear_Ratio	---	SM_Flag	---
Rear_Axle_Ratio	---	SM_Downshift_Active	---
Jcomm_Progressive_Shift_Disable	---	SM_High_Load	---
Out_Of_Gear	---	SM_Low_Load	---
PTO_Status	---	SM_Save_Last_Ref_Speed	RPM
VSS_Signal_Lost_Error	---	SM_Target_Speed	RPM

[SM] Determine Shift Manager Torque Thresholds:

Filtered_Engine_Speed	RPM	SM_Engine_Torque	FT*LB
Net_Machine_Torque	FT*LB	SM_Torque_Accel	FT*LB
MME_Vehicle_Mass	LBM	MME_Torque_Aero	FT*LB
MME_Tire_Radius	FT	MME_Torque_Rolling	FT*LB
Filtered_Gear_Ratio	---	MME_Torque_Grade	FT*LB
Rear_Axle_Ratio	---	MME_Torque_Transmission	FT*LB
Fan_Torque	FT*LB	MME_Torque_Axle	FT*LB
Road_Speed	MPH	SM_Torque_Threshold	FT*LB

[SM] Determine Shift Manager Status:

Filtered_Engine_Speed	RPM	SM_Low_Load	---
Filtered_Gear_Ratio	---	SM_High_Load	---
Out_Of_Gear	---	SM_Downshift_Active	---
SM_In_Gear_Gear_Ratio	---	SM_Flag	---
SM_Engine_Torque	FT*LB		
SM_Torque_Threshold	FT*LB		

[MME] Machine Mass Estimator:

Filtered_Engine_Speed	RPM	MME_Torque_Threshold	FT*LB
FSS_Total_Fueling	MG/STROKE	MME_Torque_Accel	FT*LB
Fueling_Control_State_Value	---	MME_Torque_Aero	FT*LB
Net_Machine_Torque	FT*LB	MME_Torque_Axle	FT*LB
Filtered_Gear_Ratio	---	MME_Torque_Grade	FT*LB
Road_Speed	MPH	MME_Torque_Rolling	FT*LB
MME_Machine_Torque	FT*LB	MME_Torque_Transmission	FT*LB
MME_Vehicle_Mass	LBM		

[MME] Estimated Torque For Acceleration:

Filtered_Engine_Speed	RPM	MME_Torque_Aero	FT*LB
Road_Speed	MPH	MME_Torque_Axle	FT*LB
MME_Tire_Radius	FT	MME_Torque_Rolling	FT*LB
Filtered_Gear_Ratio	---	MME_Torque_Transmission	FT*LB
Rear_Axle_Ratio	---	MME_Machine_Torque_At_Wheels	FT*LB
MME_Vehicle_Mass	LBM	MME_Excess_Machine_Torque	FT*LB
Net_Machine_Torque	FT*LB	MME_Torque_Threshold	FT*LB
MME_Machine_Torque	FT*LB	MME_Min_Torque_Timer	SEC

[MME] Vehicle Mass Estimation:

Filtered_Engine_Speed	RPM	MME_Engine_Inertia_At_Wheels	LBF*FT*SEC^2
Filtered_Gear_Ratio	---	MME_Estimated_GCVW	LBM
Rear_Axle_Ratio	---	MME_Average_GCVW	LBM
MME_Tire_Radius	FT	MME_Adjusted_Avg_GCVW	LBM
Road_Speed	MPH	MME_Vehicle_Acceleration	FT/SEC^2
Net_Machine_Torque	FT*LB	MME_Vehicle_Mass	LBM
MME_Excess_Machine_Torque	FT*LB	T_MME_Vehicle_Weight	LBM

[MME] Optimal Torque Range:

Filtered_Engine_Speed	RPM	MME_Torque_Aero	FT*LB
Filtered_Gear_Ratio	---	MME_Torque_Axle	FT*LB
Rear_Axle_Ratio	---	MME_Torque_Rolling	FT*LB
Out_of_Gear	---	MME_Torque_Transmission	FT*LB
MME_Tire_Radius	FT	MME_Torque_Grade	FT*LB
MME_Vehicle_Mass	LBM	MME_Torque_Accel	FT*LB
MME_Vehicle_Acceleration	FT/SEC^2	MME_Max_Torque_Threshold	FT*LB
Fan_Torque	FT*LB	C_MME_Min_Torque_Threshold	FT*LB
Net_Machine_Torque	FT*LB	C_MME_Min_Transient_Torque_Thd	FT*LB

[MME] Monitor Vehicle Data For Changes In Engine Conditions:

Filtered_Engine_Speed	RPM	MME_OOG_Road_Speed_1	MPH
Net_Machine_Torque	FT*LB	MME_OOG_Road_Speed_2	MPH
MME_Vehicle_Mass	LBM	MME_OOG_Road_Speed_Delta	MPH
MME_Estimated_GCVW	LBM	MME_Start_Data_Processing	---
Filtered_Gear_Ratio	---	MME_Data_Processing_Complete	---
Out_of_Gear	---	MME_Major_Chage_Confirmed	---
MME_Collect_Data	---	MME_Mass_Increase_Confirmed	---
MME_OOG_Road_Speed_Delta	MPH	MME_Total_Samples	---
MME_OOG_Time	SEC	MME_Average_GCVW	LBM
MME_Road_Grade_Detected	---	MME_Major_Change_Flag	---
Road_Speed	MPH	MME_Major_Mass_Increase_Flag	---

123. CORS Centinel

Filtered_Engine_Speed	RPM	CORS_Fuel_Used	GAL
Total_Fueling	MG/STROKE	CORS_Makeup_Fuel_Used	GAL
Fueling_Control_State	---	CORS_Missed_Pulse_Count	---
TQM_Final_Torque_Cmd	FT*LB	CORS_Burn_Valve_Command	---
Road_Speed	MPH	CORS_Remote_Oil_Level_Low	---
Engine_State	---	CORS_Remote_Oil_Counter	SEC
Fuel_Delivery_Rate_Gallons	GAL/SEC	CORS_Burn_Valve_Driver_PWM_High_Control_Error	---
CORS_Remote_Oil_Level_Switch	---	CORS_Burn_Valve_Driver_PWM_Low_Control_Error	---
Oil_Press	PSI	OLM_Very_Low_Oil_Level_Error	---
Oil_Tmptr	DEG_F	OLM_Very_Low_Oil_Sensor_Error	---
Oil_Temperature_High_Error	---	Oil_Pressure_High_Postprocessed_Error	---
Oil_Temperature_Low_Error	---	Oil_Pressure_Low_Error	---

124. Automated Transmissions

Filtered_Engine_Speed	RPM	VSS_Transmission	---
FSS_Total_Fueling	MG/STROKE	RSC_Sensor_Type	---
Fueling_Control_State_Value	---	Road_Speed	MPH
Net_Engine_Torque	FT*LB	Commanded_Throttle	%THROTTLE
No_Load_Torque	FT*LB	Jcomm_Engine_Control_Mode	---
TQM_Final_Torque_Cmd	FT*LB	Jcomm_Retarder_Control_Mode	---
Jcomm_Speed_Governor_Mode	---	Jcomm_Reference_RPM	RPM
Effective_Gear_Ratio	---	Jcomm_Engine_Torque_Command	%
Road_Speed	MPH	Jcomm_Derate_Torque	FT*LB
E_Brake_Status	---	Jcomm_Engine_Brake_Limit	FT*LB
Fan_Torque	FT*LB	J1939_Gear_Ratio	---
E_Brake_Command_Source	---	Jcomm_Engine_Control_Device_Indicator	---
		E_Brake_Jcomm_Device_Indicator	---

125. Powertrain Controls

Powertrain Control References:

Filtered_Engine_Speed	RPM	Jcomm_Engine_Control_Mode	---
Total_Fueling	MG/STROKE	Jcomm_Engine_Torque_Command	%
Fueling_Control_State	---	Reference_Engine_Torque	N*M
TQM_Final_Torque_Cmd	FT*LB	Jcomm_Reference_RPM	RPM
No_Load_Torque	FT*LB	Powertrain_Reference_RPM	RPM
Fan_Torque	FT*LB	Powertrain_Commanded_Torque	FT*LB
Road_Speed	MPH	Powertrain_State	---
Commanded_Throttle	%THROTTLE	Torque_Derived_Ndot_Powertrain	---

Powertrain Control Governor Gains:

Filtered_Engine_Speed	RPM	Commanded_Throttle	%THROTTLE
Total_Fueling	MG/STROKE	Powertrain_Reference_RPM	RPM
Fueling_Control_State	---	Powertrain_State	---
TQM_Final_Torque_Cmd	FT*LB	Powertrain_Proportional_Gain	1/SEC
Jcomm_Speed_Governor_Mode	---	Powertrain_Base_Proportional_Gain	1/SEC
Effective_Gear_Ratio	---	Powertrain_Gain_Multiplier	---
E_Brake_Status	---	Powertrain_Gain_Factor	1/SEC
Road_Speed	MPH		

Powertrain Control Ndot Governor:

Filtered_Engine_Speed	RPM	Powertrain_Commanded_Torque	FT*LB
Total_Fueling	MG/STROKE	Powertrain_Reference_RPM	RPM
Fueling_Control_State	---	Powertrain_State	---
TQM_Final_Torque_Cmd	FT*LB	Powertrain_Commanded_Torque_Error	FT*LB
Jcomm_Derate_Torque	FT*LB	Powertrain_Limiting_Torque_Error	FT*LB
Ndot_Feedforward_Gain	---	Powertrain_Error	RPM
Ndot_Integral_Torque	FT*LB	Ndot_Powertrain	RPM/SEC
Road_Speed	MPH	Ndot_Demand	RPM/SEC
Commanded_Throttle	%THROTTLE	Ndot_Error	RPM/SEC
		Ndot_Powertrain_Torque_Limit	RPM/SEC

126. Powertrain Protection

Filtered_Engine_Speed	RPM	PTP_Switched_Input	---
Total_Fueling	MG/STROKE	PTP_Torque_Output	FT*LB
Fueling_Control_State	---	PTP_Lugback_State	---
TQM_Final_Torque_Cmd	FT*LB	PTP_P_Load	%LOAD
Net_Machine_Torque	FT*LB	PTP_TC_Limit	FT*LB
TQM_Machine_Torque_Limit	FT*LB	Vehicle_Deceleration	MPH/SEC
TQM_Machine_Torque_Limit_State	---		
Road_Speed	MPH		

127. Limp Home Mode

Filtered_Engine_Speed	RPM	Ndot_Limp_Home	RPM/SEC
Total_Fueling	MG/STROKE	Ndot_Demand	RPM/SEC
Fueling_Control_State	---	Ndot_Error	RPM/SEC
TQM_Final_Torque_Cmd	FT*LB	Limp_Home_Filtered_Engine_Speed	RPM
Net_Machine_Torque	FT*LB	Limp_Home_Max_Net_Torque	FT*LB
Ndot_Integral_Torque	FT*LB	Limp_Home_Net_Torque	FT*LB
Ndot_Feedforward_Gain	---	Limp_Home_Net_Torque_Limit	FT*LB
Commanded_Throttle	%THROTTLE	Limp_Home_Torque_Error	FT*LB
Throttle_Status	---		
Road_Speed	MPH	J1939_Mux_APS_Data_Error	HEX
		J1939_Mux_APS_PGN_Timeout_Error	HEX

128. Out Of Gear Protection

Filtered_Engine_Speed	RPM	Out_Of_Gear_Desired_Torque	FT*LB
Total_Fueling	MG/STROKE	Out_Of_Gear_Protection_State	---
Fueling_Control_State	---	Out_Of_Gear_Torque	FT*LB
TQM_Final_Torque_Cmd	FT*LB	Net_Machine_Torque	FT*LB
Coolant_Torque_Adjustment	FT*LB		
Coolant_Tmptr	DEG_F	Desired_User_Fueling_State	---
Filtered_Gear_Ratio	---	VSS_Transmission	---
Out_Of_Gear	---		
Road_Speed	MPH		
RSG_Desired_Reference_Speed	MPH		

129. Gear Down Protection

Filtered_Engine_Speed	RPM	GC_Filtered_Percent_Load	%
Total_Fueling	MG/STROKE	GD_State	---
Fueling_Control_State	---		
TQM_Final_Torque_Cmd	FT*LB	Max_Road_Speed	MPH
Road_Speed	MPH	Cruise_Max_Road_Speed	MPH
Cruise_Control_Reference_Speed	MPH	GD_Low_Limit_Speed	MPH
Cruise_Control_Status	---	GD_High_Limit_Speed	MPH
SR_Reference_Speed	MPH	RSG_Desired_Reference_Speed	MPH
DR_RSG_CC_Delta	MPH	RSG_Reference_Speed	MPH
Filtered_Gear_Ratio	---	SR_Reference_Speed	MPH
Gear_Down_Active	---	DR_Max_Offset	MPH
Rear_Axle_Ratio_Switch	---		
Percent_Load	%		

130. Starter Lockout

Engine_State	---	Starter_Lockout_Driver	---
Filtered_Engine_Speed	RPM	Starter_Lockout_Driver_PWM_Duty_Cycle	%
Keyswitch	---	SL_Started	---
		Starter_Lockout_Request	---
		Starter_Inhibit	HEX

131. Remote Throttle Control

Calculated_Commanded_Throttle	%THROTTLE	Alternate_Throttle	%THROTTLE
Remote_Throttle	%	Remote_Throttle_Diagnostics_Enable_Flag	---
Remote_Throttle_Raw	CNTS	RT_High_Error	---
Remote_Throttle_High_Error	---	RT_Low_Error	---
Remote_Throttle_Low_Error	---	Throttle_Selection	DEC
Remote_Throttle_Switch	---	J1939_Mux_APS_PGN_Timeout_Error	HEX
		J1939_Mux_Remote_Throttle_Data_Error	---

132. Remote PTO Control

Remote_PTO_Switch	---	Ndot_Net_Torque_Cmd	FT*LB
Alternate_Throttle_Selection_State	---	Net_Machine_Torque	FT*LB
Filtered_Engine_Speed	RPM	PTO_Reference_Speed	RPM
PTO_Status	---	PTO_Speed_Selected	RPM
PTO_State	---	PTO_Remote_Throttle_Inhibit	---
Fueling_Control_State	---	PTO_Remote_PTO_Inhibit	---
Total_Fueling	MG/STROKE	PTO_Derate_Torque	FT*LB

133. Idle Shutdown

Filtered_Engine_Speed	RPM	Brake_Switch	---
Total_Fueling	MG/STROKE	Clutch_Switch	---
TQM_Final_Torque_Cmd	FT*LB	VSS_Signal_Lost_ Error	---
Fueling_Control_State	---	PTO_Status	---
Engine_State	---		
OEM_Ambient_Air_Tmptr	DEG_F	Idle_Shutdown_Override_Flag	HEX
Ambient_Air_Tmptr	DEG_F	Idle_Shutdown_Reset_Flag	HEX
Intake_Manifold_Temperature_Sensor	DEG_F	Idle_Shutdown_Reset_From_Warning_Flag	HEX
Commanded_Throttle	%THROTTLE	Idle_Shutdown_Reset_From_Override_Flag	HEX
Road_Speed	MPH		

134. Turboconveyor

Filtered_Engine_Speed	RPM	Turbine_Pressure_Ratio	---
FSS_Total_Fueling	MG/STROKE	C_Turboconveyor_Pratio_Thd	---
Fueling_Control_State_Value	---	C_Turboconveyor_Turbo_Speed_Thd	KRPM
Exhaust_Press	IN_HG	C_Turboconveyor_Enable_Time	SEC
Ambient_Air_Press	IN_HG	Turboconveyor_Is_Active	---
Filtered_Turbo_Speed	KRPM	EMO_Gen_Protect_AECD_State	---
PTO_Status	---	EMM_AECD_State	---
Exhaust_Tmptr	DEG_F	EMM_Protection_State	---
CBR_Chi_Value	---	EGR_Valve_Is_Closed	---

135. Ether Start Injection

Filtered_Engine_Speed	RPM	Ether_Injection_Driver_PWM_Duty_Cycle	%
FSS_Total_Fueling	MG/STROKE	Ether_Injection_Driver_PWM_Period	USEC
Fueling_Control_State_Value	---	Ether_Injection_Delay_Timer	SEC
Coolant_Tmptr	DEG_F	Ether_Injection_Cranking_Timer	SEC
EGR_Valve_Is_Closed	---	Ether_Injection_Preload_Timer	SEC
Engine_State	---	Ether_Injection_Pulse_Off_Time	SEC
EPS_Status	---	Ether_Preload_Done_Flag	---
Battery_Volt	VOLT	Ether_Request_Flag	---
		Ether_Starting_Done_Flag	---
Ether_Injection_Driver_PWM_Low_Control_Error	---	Ether_Preload_Active_Flag	---
Ether_Injection_Driver_PWM_High_Control_Error	---	Ether_Solenoid_Command	---

Engineering Features:

136. User Overrides

USER OVERRIDE ENABLES:	*OVERRIDES:*	*USER OVERRIDE VALUES:*	
User_Override_Fueling_Enable	Total_Fueling	User_Override_Fueling	MG/STROKE
T_CBR_Fuel_Ref_User_Override	CBR_Fuel_Ref	C_CBR_Fuel_Ref_Override_Value	MG/STROKE
T_CBL_Fuel_User_Override	CBL_Fuel_Cmd	C_CBL_Fuel_Override_Value	MG/STROKE
T_OFC_Fuel_Limit_User_Override	OFC_Fuel_Limit	C_OFC_Fuel_Limit_Override_Value	MG/STROKE
User_Override_Timing_Enable	Final_Timing	User_Override_Timing	CRANK_DEG
T_CBL_SOI_User_Override	CBL_SOI_Cmd	C_CBL_SOI_Override_Value	CRANK_DEG
T_CBL_SOI_Increment_Enable	CBL_SOI_Ref	C_CBL_SOI_Increment	CRANK_DEG
User_Commanded_Torque_Enable	Ndot_Net_Torque_Cmd	User_Commanded_Torque	FT*LB
Alpha_User_Override_Enable	Alpha	User_Override_Alpha	---
T_CBR_Alpha_User_Override	CBR_Alpha	C_CBR_Alpha_Override_Value	---
T_CBR_Chi_User_Override	CBR_Chi_Value	C_CBR_Chi_Override_Value	---
T_CBR_Chi_Selective_Override	CBR_Chi_Value	C_CBR_Chi_Override_Value	---
T_CBL_EGR_Frac_User_Override	CBL_EGR_Frac_Cmd	C_CBL_EGR_Frac_Override_Value	---
T_CBL_MCF_User_Override	CBL_MCF_Cmd	C_CBL_MCF_Override_Value	LB/MIN
T_CSE_Xform_User_Override	CSE_Xform_Angle	C_CSE_Xform_Override_Value	DEG
T_EGA_Cmd_User_Override	EGA_Position_Cmd_Final	C_EGA_Cmd_Override_Value	%open
T_EGA_PWM_User_Override	EGA_PWM_Limited	C_EGA_PWM_Override_Value	%DutyCycle
VGT_Duty_Cycle_Override_Enable	VGT_Duty_Cycle	VGT_Duty_Cycle_Override	%DutyCycle

137. Torque To Fuel Conversion

Inputs to Fuel System Controls (Command):		*Output from Fuel System Controls (Feedback):*	
Filtered_Engine_Speed	RPM	FSI_q_totalFueling_v	MG/STROKE
Total_Fueling	MG/STROKE	FSS_Total_Fueling	MG/STROKE
Fueling_Control_State	---	CBP_Adj_Total_Fueling	MG/STROKE
Ndot_Net_Torque_Cmd	FT*LB	Charge_Flow	LB/MIN
Ndot_Integral_Torque	FT*LB	CBP_Adj_Charge_Flow	LB/MIN
TQM_Final_Torque_Cmd	FT*LB	CBP_Combustion_Torque	FT*LB
TQM_Engine_Torque_Limit	FT*LB	CBP_EB_Torque	FT*LB
TQM_Machine_Torque_Limit	FT*LB	Net_Engine_Torque	FT*LB
CBR_Gross_Fuel	MG/STROKE	Net_Machine_Torque	FT*LB
CBR_Fuel_Ref	MG/STROKE	No_Load_Torque	FT*LB

138. Keyon Pressure Check Diagnostics

Keyswitch	---	Ambient_Air_Press_Sensor_Tolerence	IN_HG
Air_Pressure_Sensor_Raw	CNTS	Charge_Press_Sensor_Tolerence	IN_HG
Boost_Pressure_Absolute_Raw	CNTS	Exhaust_Press_Sensor_Tolerence	IN_HG
Exhaust_Pressure_Sensor_Raw	CNTS	Oil_Press_Sensor_Tolerence	PSI_A
Oil_Pressure_Absolute_Raw	CNTS	C_EGR_DP_IR_Startup_Pos_Thd	%open
Ambient_Air_Press	IN_HG	C_EGR_DP_IR_Startup_Press_Thd	IN_HG
Charge_Press	IN_HG	Air_Pressure_Keyon_Error	---
Exhaust_Press	IN_HG	Charge_Pressure_Keyon_Error	---
Oil_Press	PSI	Exhaust_Pressure_Keyon_Error	---
EGR_Delta_Press	IN_HG	Oil_Pressure_Keyon_Error	---
C_EGR_DP_IR_Startup_Delay_Time	SEC	EGR_Delta_Press_Keyon_Error	---

139. General Engine Protection (EPF)

Filtered_Engine_Speed	RPM	Compressor_Outlet_Tmptr	DEG_F
Total_Fueling	MG/STROKE	Coolant_Level	VOLT
TQM_Final_Torque_Cmd	FT*LB	Coolant_Tmptr	DEG_F
Fueling_Control_State	---	Oil_Level_Sensor	GAL
Throttle_100_Torque	FT*LB	EGR_Orifice_Tmptr	DEG_F
Engine_Protection_Derate_Torque	FT*LB	Exhaust_Metal_Tmptr	DEG_F
EPF_Torque_Limit_Status	---	Charge_Tmptr	DEG_F
EPF_Max_Torque_Limit_Index	---	Oil_Press	PSI
		Oil_Tmptr	DEG_F

ENGINE PROTECTION PARAMETERS

[EPF] Compressor Outlet Temperature Engine Protection:

Compressor_Outlet_Tmptr	DEG_F	*Engine Protection Limits:*	
COT_Torque_Index	---	COT_RPM_Lower_Limit	DEG_F
COT_Torque_Error	---	COT_RPM_Shutdown_Severity_Thres	DEG_F
COT_RPM_Index	---	COT_Torque_Max_Threshold	DEG_F
COT_RPM_Error	---	COT_Torque_Min_Threshold	DEG_F
		COT_Torque_Shutdown_Severity_Thres	DEG_F
COT_Torque_Duration	SEC	COT_Torque_Derate_Start_Duration	SEC
COT_RPM_Duration	SEC	COT_Torque_Shutdown_Duration_Thres	SEC
		COT_RPM_Derate_Start_Duration	SEC
		COT_RPM_Shutdown_Duration_Thres	SEC

[EPF] Coolant Level Engine Protection:

Coolant_Level	VOLT	*Engine Protection Limits:*	
Coolant_Level_Torque_Index	---	Coolant_Level_RPM_Lower_Limit	VOLT
Coolant_Level_Torque_Error	---	Coolant_Level_RPM_Shutdown_Severity_Thres	VOLT
Coolant_Level_RPM_Index	---	Coolant_Level_Torque_Max_Threshold	VOLT
Coolant_Level_RPM_Error	---	Coolant_Level_Torque_Min_Threshold	VOLT
		Coolant_Level_Torque_Shutdown_Severity_Thres	VOLT
Coolant_Level_Torque_Duration	SEC	Coolant_Level_Torque_Derate_Start_Duration	SEC
Coolant_Level_RPM_Duration	SEC	Coolant_Level_Torque_Shutdown_Duration_Thres	SEC
		Coolant_Level_RPM_Derate_Start_Duration	SEC
		Coolant_Level_RPM_Shutdown_Duration_Thres	SEC

[EPF] Coolant Temperature Engine Protection:

Coolant_Temperature	DEG_F	*Engine Protection Limits:*	
Coolant_Tmptr	DEG_F	Coolant_Temperature_RPM_Lower_Limit	DEG_F
Coolant_Temperature_Torque_Index	---	Coolant_Temperature_RPM_Shutdown_Severity_Thres	DEG_F
Coolant_Temperature_Torque_Error	---	Coolant_Temperature_Torque_Max_Threshold	DEG_F
Coolant_Temperature_RPM_Index	---	Coolant_Temperature_Torque_Min_Threshold	DEG_F
Coolant_Temperature_RPM_Error	---	Coolant_Temperature_Torque_Shutdown_Severity_Thres	DEG_F
		Coolant_Temperature_Torque_Derate_Start_Duration	SEC
Coolant_Temperature_Torque_Duration	SEC	Coolant_Temperature_Torque_Shutdown_Duration_Thres	SEC
Coolant_Temperature_RPM_Duration	SEC	Coolant_Temperature_RPM_Derate_Start_Duration	SEC
		Coolant_Temperature_RPM_Shutdown_Duration_Thres	SEC

[EPF] Coolant Temp2 Engine Protection:

Coolant_Temperature	DEG_F	*Engine Protection Limits:*	
Coolant_Tmptr	DEG_F	Coolant_Temp2_RPM_Lower_Limit	DEG_F
Coolant_Temp2_Torque_Index	---	Coolant_Temp2_RPM_Shutdown_Severity_Thres	DEG_F
Coolant_Temp2_Torque_Error	---	Coolant_Temp2_Torque_Max_Threshold	DEG_F
Coolant_Temp2_RPM_Index	---	Coolant_Temp2_Torque_Min_Threshold	DEG_F
Coolant_Temp2_RPM_Error	---	Coolant_Temp2_Torque_Shutdown_Severity_Thres	DEG_F
		Coolant_Temp2_Torque_Derate_Start_Duration	SEC
Coolant_Temp2_Torque_Duration	SEC	Coolant_Temp2_Torque_Shutdown_Duration_Thres	SEC
Coolant_Temp2_RPM_Duration	SEC	Coolant_Temp2_RPM_Derate_Start_Duration	SEC
		Coolant_Temp2_RPM_Shutdown_Duration_Thres	SEC

[EPF] EGR Orifice Temperature Engine Protection:

EGR_Orifice_Tmptr	DEG_F	*Engine Protection Limits:*	
EGR_Orifice_Tmptr_Torque_Index	---	EGR_Orifice_Tmptr_Temperature_RPM_Lower_Limit	DEG_F
EGR_Orifice_Tmptr_Torque_Error	---	EGR_Orifice_Tmptr_RPM_Shutdown_Severity_Thres	DEG_F
EGR_Orifice_Tmptr_RPM_Index	---	EGR_Orifice_Tmptr_Torque_Max_Threshold	DEG_F
EGR_Orifice_Tmptr_RPM_Error	---	EGR_Orifice_Tmptr_Torque_Min_Threshold	DEG_F
		EGR_Orifice_Tmptr_Torque_Shutdown_Severity_Thres	DEG_F
EGR_Orifice_Tmptr_Torque_Duration	SEC	EGR_Orifice_Tmptr_Torque_Derate_Start_Duration	SEC
EGR_Orifice_Tmptr_RPM_Duration	SEC	EGR_Orifice_Tmptr_Torque_Shutdown_Duration_Thres	SEC
		EGR_Orifice_Tmptr_RPM_Derate_Start_Duration	SEC
		EGR_Orifice_Tmptr_RPM_Shutdown_Duration_Thres	SEC

[EPF] EGR Orifice Temp2 Engine Protection:

EGR_Orifice_Tmptr	DEG_F	*Engine Protection Limits:*	
EGR_Orifice_Temp2_Torque_Index	---	EGR_Orifice_Temp2_RPM_Lower_Limit	DEG_F
EGR_Orifice_Temp2_Torque_Error	---	EGR_Orifice_Temp2_RPM_Shutdown_Severity_Thres	DEG_F
EGR_Orifice_Temp2_RPM_Index	---	EGR_Orifice_Temp2_Torque_Max_Threshold	DEG_F
EGR_Orifice_Temp2_RPM_Error	---	EGR_Orifice_Temp2_Torque_Min_Threshold	DEG_F
		EGR_Orifice_Temp2_Torque_Shutdown_Severity_Thres	DEG_F
EGR_Orifice_Temp2_Torque_Duration	SEC	EGR_Orifice_Temp2_Torque_Derate_Start_Duration	SEC
EGR_Orifice_Temp2_RPM_Duration	SEC	EGR_Orifice_Temp2_Torque_Shutdown_Duration_Thres	SEC
		EGR_Orifice_Temp2_RPM_Derate_Start_Duration	SEC
		EGR_Orifice_Temp2_RPM_Shutdown_Duration_Thres	SEC

[EPF] Exhaust Temperature Engine Protection:

Exhaust_Tmptr	DEG_F	*Engine Protection Limits:*	
Exhaust_Metal_Tmptr	DEG_F	Exhaust_Metal_Tmptr_RPM_Lower_Limit	DEG_F
Exhaust_Metal_Tmptr_Torque_Index	---	Exhaust_Metal_Tmptr_RPM_Shutdown_Severity_Thres	DEG_F
Exhaust_Metal_Tmptr_Torque_Error	---	Exhaust_Metal_Tmptr_Torque_Max_Threshold	DEG_F
Exhaust_Metal_Tmptr_RPM_Index	---	Exhaust_Metal_Tmptr_Torque_Min_Threshold	DEG_F
Exhaust_Metal_Tmptr_RPM_Error	---	Exhaust_Metal_Tmptr_Torque_Shutdown_Severity_Thres	DEG_F
		Exhaust_Metal_Tmptr_Torque_Derate_Start_Duration	SEC
Exhaust_Metal_Tmptr_Torque_Duration	SEC	Exhaust_Metal_Tmptr_Torque_Shutdown_Duration_Thres	SEC
Exhaust_Metal_Tmptr_RPM_Duration	SEC	Exhaust_Metal_Tmptr_RPM_Derate_Start_Duration	SEC
		Exhaust_Metal_Tmptr_RPM_Shutdown_Duration_Thres	SEC

[EPF] Intake Manifold Temperature Sensor Engine Protection:

Intake_Manifold_Temperature_Sensor	DEG_F	*Engine Protection Limits:*	
Charge_Tmptr	DEG_F	IMT_RPM_Lower_Limit	DEG_F
IMT_Torque_Index	---	IMT_RPM_Shutdown_Severity_Thres	DEG_F
IMT_Torque_Error	---	IMT_Torque_Max_Threshold	DEG_F
IMT_RPM_Index	---	IMT_Torque_Min_Threshold	DEG_F
IMT_RPM_Error	---	IMT_Torque_Shutdown_Severity_Thres	DEG_F
		IMT_Torque_Derate_Start_Duration	SEC
IMT_Torque_Duration	SEC	IMT_Torque_Shutdown_Duration_Thres	SEC
IMT_RPM_Duration	SEC	IMT_RPM_Derate_Start_Duration	SEC
		IMT_RPM_Shutdown_Duration_Thres	SEC

[EPF] Oil Pressure Engine Protection:

Oil_Pressure	PSI	*Engine Protection Limits:*	
Oil_Press	PSI	Oil_Pressure_RPM_Lower_Limit	PSI
Oil_Pressure_Torque_Index	---	Oil_Pressure_RPM_Shutdown_Severity_Thres	PSI
Oil_Pressure_Torque_Error	---	Oil_Pressure_Torque_Max_Threshold	PSI
Oil_Pressure_RPM_Index	---	Oil_Pressure_Torque_Min_Threshold	PSI
Oil_Pressure_RPM_Error	---	Oil_Pressure_Torque_Shutdown_Severity_Thres	PSI
		Oil_Pressure_Torque_Derate_Start_Duration	SEC
Oil_Pressure_Torque_Duration	SEC	Oil_Pressure_Torque_Shutdown_Duration_Thres	SEC
Oil_Pressure_RPM_Duration	SEC	Oil_Pressure_RPM_Derate_Start_Duration	SEC
		Oil_Pressure_RPM_Shutdown_Duration_Thres	SEC

[EPF] Oil Temperature Engine Protection:

Oil_Temperature	DEG_F	*Engine Protection Limits:*	
Oil_Tmptr	DEG_F	Oil_Temperature_RPM_Lower_Limit	DEG_F
Oil_Temperature_Torque_Index	---	Oil_Temperature_RPM_Shutdown_Severity_Thres	DEG_F
Oil_Temperature_Torque_Error	---	Oil_Temperature_Torque_Max_Threshold	DEG_F
Oil_Temperature_RPM_Index	---	Oil_Temperature_Torque_Min_Threshold	DEG_F
Oil_Temperature_RPM_Error	---	Oil_Temperature_Torque_Shutdown_Severity_Thres	DEG_F
		Oil_Temperature_Torque_Derate_Start_Duration	SEC
Oil_Temperature_Torque_Duration	SEC	Oil_Temperature_Torque_Shutdown_Duration_Thres	SEC
Oil_Temperature_RPM_Duration	SEC	Oil_Temperature_RPM_Derate_Start_Duration	SEC
		Oil_Temperature_RPM_Shutdown_Duration_Thres	SEC

140. In-Range Diagnostics

Charge Pressure In-Range Diagnostics:

Filtered_Engine_Speed	RPM	Charge_Press_Tolerance	IN_HG
FSS_Total_Fueling	MG/STROKE	Charge_Press_Default	IN_HG
Fueling_Control_State_Value	---	Charge_Press_Keyon_Error	---
Charge_Press	IN_HG	Charge_Press_Source	---
Charge_Press_Sensor	IN_HG	Charge_Press_State	---
Charge_Press_Est	IN_HG	Charge_Press_IR_Enable	---
Charge_Press_Status	---	Charge_Press_IR_Cond	---
Charge_Press_Estat	---	Charge_Press_IR_Error	---
Charge_Press_Est_Offset	IN_HG	Charge_Press_IR_Fault_Cnt	CNTS
		T_Charge_Press_IR_Enable	HEX

Turbo Speed In-Range Diagnostics:

Filtered_Engine_Speed	RPM	Turbo_Speed_Source	---
FSS_Total_Fueling	MG/STROKE	Turbo_Speed_Disabled	---
Fueling_Control_State_Value	---	Turbo_Speed_State	---
Filtered_Turbo_Speed	KRPM	Turbo_Speed_IR_State	---
Turbo_Speed_Sensor	KRPM	Turbo_Speed_IR_Enable	---
Turbo_Speed_Est	KRPM	Turbo_Speed_IR_Cond	---
Turbo_Speed_Status	---	Turbo_Speed_In_Range_Error	---
Turbo_Speed_Estat	---	Turbo_Speed_IR_Fault_Count	CNTS
Turbo_Speed_Comparison_Value	KRPM		
		T_Turbo_Speed_IR_Enable	HEX

EGR Delta P In-Range Rationality Diagnostics:

Filtered_Engine_Speed	RPM	EGR_DP_IR_Open_Error	---
Net_Engine_Torque	FT*LB	EGR_DP_IR_Open_Enable_Cond	---
EGR_Position	%open	EGR_DP_IR_Open_Fault_Cond	---
Engine_Delta_Press	IN_HG	EGR_DP_IR_Open_Fault_Cnt	CNTS
EGR_Delta_Press_AP	IN_HG	EGR_DP_IR_Closed_Error	---
EGR_Delta_Press_State	---	EGR_DP_IR_Closed_Enable_Cond	---
EGR_Delta_Press_Keyon_Error	---	EGR_DP_IR_Closed_Fault_Cond	---
EGR_Delta_Press	IN_HG	EGR_DP_IR_Closed_Fault_Cnt	CNTS
EGR_Delta_Press_Source	---	EGR_DP_IR_Error	---
		T_EGR_DP_IR_Enable	HEX

141. ECM Parameters

Calibration_Version_Number	HEX	ECM_Internal_Tmptr	DEG_F
Boot_Loader_Phase_Designation	HEX	ECM_Internal_Tmptr_Source	---
Reset_Count	---	ECM_Internal_Tmptr_Status	---
ECM_STAT	HEX	Max_ECM_Tmptr	DEG_F
ECM_Status	HEX	Throughput_Percent_Busy	%
RUN_TIME	SEC	Throughput_Percent_Idle	%
SEC_KEY	HEX	Throughput_Time	MSEC
Battery_Voltage	VOLT	FTM_p_throughput_v	%

HPI-TP Fuel System:

142. Fuel Systems Interface (FSI)

Filtered_Engine_Speed	RPM		
Fueling_Control_State	---		
FUEL SYSTEM OUTPUT PARAMETERS:		*BASE CONTROL SYSTEM PARAMETERS:*	
FSI_q_totalFueling_v	MG/STROKE	Total_Fueling	MG/STROKE
FSI_ca_mainSOI_v	CRANK_DEG	Final_Timing	CRANK_DEG
FSI_lp_Gallery_v	MBAR	Fuel_Rail_Pressure	PSI
FSI_lp_FlFilterln_v	MBAR	Fuel_Pressure	PSI
FSI_v_batt_v	VOLT	Battery_Voltage	VOLT
FSI_t_fuel_v	---	Fuel_Temperature	DEG_F
FSI_t_coolant_v	---	Coolant_Temperature	DEG_F
FSI_lp_Boost_v	MBAR	Boost_Pressure_Absolute	IN_HG
FSI_s_stopFuel_c	1 = OVERRIDE	Overrides FSI_q_totalFueling_c and FSI_ca_mainSOI_v	
FSI_s_stopOutputs_c	1 = OVERRIDE	Suspends calculation of FSSC to Base Control System	

143. Engine Speed Processing (EPS)

Filtered_Engine_Speed	RPM	Fueling_Control_State	---
EPS_Engine_Speed	RPM		
EPS_Status	---	EPS_Crank_Start_Type	---
EPS_Main_Sync_State	---	EPS_Cam_Cycle_State	---
EPS_Backup_Sync_State	---		

144. Fuel Pressure Compensation (PCC)

Filtered_Engine_Speed	RPM	PCC_lp_ModelPressure_v	MBAR
FSS_Total_Fueling	MG/STROKE	PCC_lp_PressureError_v	MBAR
Net_Engine_Torque	FT*LB	PCC_q_FuelComp_v	MG/STROKE
Fueling_Control_State	---	PCC_qt_TimingComp_v	MM3/STROKE
Fuel_Rail_Pressure	PSI	FTT_ti_BaseFlTTL_v	MSEC
FSI_lp_Gallery_v	MBAR	FTT_q_CompFlCmd_v	MG/STROKE
		FTT_ti_BaseTmTTL_v	MSEC
PCC_s_Enable_c	---	FTT_qt_CompTmCmd_v	MM3/STROKE

145. Fuel Temperature Compensation (FTC/TTC)

Filtered_Engine_Speed	RPM	TTC_qt_tFlowComp_v	MM3/STROKE
FSS_Total_Fueling	MG/STROKE	FTC_q_fuelingComp_v	MG/STROKE
Net_Engine_Torque	FT*LB	FTT_ti_BaseFlTTL_v	MSEC
Fueling_Control_State	---	FTT_q_CompFlCmd_v	MG/STROKE
Fuel_Temperature	DEG_F	FTT_ti_BaseTmTTL_v	MSEC
FSI_t_fuel_v	---	FTT_qt_CompTmCmd_v	MM3/STROKE
Coolant_Temperature	DEG_F		
FSI_t_coolant_v	---	TTC_s_enable_c	---
		FTC_s_enable_c	---

146. Boost Pressure Compensation (BPC)

Filtered_Engine_Speed	RPM	BPC_q_FuelComp_v	MG/STROKE
FSS_Total_Fueling	MG/STROKE	FTT_ti_BaseFlTTL_v	MSEC
Net_Engine_Torque	FT*LB	FTT_q_CompFlCmd_v	MG/STROKE
Fueling_Control_State	---	BPC_lp_BoostErr_v	MBAR
Boost_Pressure_Absolute	IN_HG		
FSI_lp_Boost_v	MBAR	BPC_s_Enable_c	---

147. Solid Fuel Height Determination (SFH)

Filtered_Engine_Speed	RPM	SFH_ca_EOI_v	CRANK_DEG
FSI_q_totalFueling_v	MG/STROKE	SFH_ca_TimingCommand_v	CRANK_DEG
Net_Engine_Torque	FT*LB	SFH_ht_FuelColumn_v	MM
Fueling_Control_State	---	SFH_qt_TimingFlow_v	MM3/STROKE
FSI_ca_mainSOI_v	CRANK_DEG	FTT_ti_BaseTmTTL_v	MSEC
FDH_ca_SOIDerate_v	CRANK_DEG	FTT_qt_CompTmCmd_v	MM3/STROKE
		SFH_ca_MaxSOILimit_c	CRANK_DEG
		SFH_ca_MinSOILimit_c	CRANK_DEG

148. Estimated Valve Delay (EVD)

Filtered_Engine_Speed	RPM	EVD_ti_EstFlEVD_v	MSEC
FSI_q_totalFueling_v	MG/STROKE	EVD_ti_EstTmEVD_v	MSEC
Net_Engine_Torque	FT*LB		
Fueling_Control_State	---	EVD_s_Enable_c	---
FSI_ca_mainSOI_v	CRANK_DEG	EVD_ti_UserFlEVD_c	MSEC
FSI_v_batt_v	VOLT	EVD_ti_UserTmEVD_c	MSEC
FSI_v_Gallery_v	MBAR		
Fuel_Rail_Pressure	PSI		

149. Flow-To-Time Conversion (FTT)

Filtered_Engine_Speed	RPM	*Inputs For Determining FTT Conversion:*	
FSI_q_totalFueling_v	MG/STROKE	SFH_ca_TimingCommand_v	CRANK_DEG
Net_Engine_Torque	FT*LB	SFH_qt_TimingFlow_v	MM3/STROKE
Fueling_Control_State	---	EVD_ti_EstFlEVD_v	MSEC
FSI_ca_mainSOI_v	CRANK_DEG	EVD_ti_EstTmEVD_v	MSEC
Boost_Pressure_Absolute	IN_HG	PCC_q_FuelComp_v	MG/STROKE
Fuel_Rail_Pressure	PSI	PCC_qt_TimingComp_v	MM3/STROKE
Battery_Voltage	VOLT	BPC_q_FuelComp_v	MG/STROKE
		TTC_qt_tFlowComp_v	MM3/STROKE
		FTC_q_fuelingComp_v	MG/STROKE
		Output From FTT Conversion Algorithm:	
		FTT_q_CompFlCmd_v	MG/STROKE
Adjustment to Fueling Pulse Time-On:		FTT_qt_CompTmCmd_v	MM3/STROKE
FTT_ti_FlAdust_c	MSEC	FTT_ti_BaseFlTTL_v	MSEC
FTT_ti_TmAdust_c	MSEC	FTT_ti_BaseTmTTL_v	MSEC

150. Cylinder Cut-Out Diagnostics (CTS)

Filtered_Engine_Speed	RPM	*Fuel Actuator Time-On Trims:*		
FSI_q_totalFueling_v	MG/STROKE	Cyl #1:	CTS_ti_FlTrim_c[0]	MSEC
FSI_ca_mainSOI_v	CRANK_DEG	Cyl #2:	CTS_ti_FlTrim_c[1]	MSEC
Fueling_Control_State	---	Cyl #3:	CTS_ti_FlTrim_c[2]	MSEC
		Cyl #4:	CTS_ti_FlTrim_c[3]	MSEC
		Cyl #5:	CTS_ti_FlTrim_c[4]	MSEC
CTS_x_ActiveFlMask_v	HEX	Cyl #6:	CTS_ti_FlTrim_c[5]	MSEC
FSI_x_ExtCylMask_c	HEX	*Timing Actuator Time-On Trims:*		
CTS_x_UserFlMask_c	HEX	Cyl #1:	CTS_ti_TmTrim_c[0]	MSEC
FSI_x_ExtCylMask_c / CTS_x_UserFlMask_c = 003E	Disables Cyl 1	Cyl #2:	CTS_ti_TmTrim_c[1]	MSEC
FSI_x_ExtCylMask_c / CTS_x_UserFlMask_c = 001F	Disables Cyl 6	Cyl #3:	CTS_ti_TmTrim_c[2]	MSEC
FSI_x_ExtCylMask_c / CTS_x_UserFlMask_c = 0038	Disables Cyl 1-3	Cyl #4:	CTS_ti_TmTrim_c[3]	MSEC
FSI_x_ExtCylMask_c / CTS_x_UserFlMask_c = 0007	Disables Cyl 4-6	Cyl #5:	CTS_ti_TmTrim_c[4]	MSEC
CTS_x_UserTmMask_c	HEX	Cyl #6:	CTS_ti_TmTrim_c[5]	MSEC

151. Cylinder Balancing Diagnostics (CBD)

Filtered_Engine_Speed	RPM	CBD_s_compensation_c	---
FSI_q_totalFueling_v	MG/STROKE		
FSI_ca_mainSOI_v	CRANK_DEG	*CBD Fueling Adjustments:*	
Fueling_Control_State	---	*Large Positive Adjustment = Weak Cylinder*	
		Large Negative Adjustment = Strong Cylinder	
		Cyl #1: FSI_q_cbdTotalAdj_v[0]	MSEC
		Cyl #2: FSI_q_cbdTotalAdj_v[1]	MSEC
		Cyl #3: FSI_q_cbdTotalAdj_v[2]	MSEC
		Cyl #4: FSI_q_cbdTotalAdj_v[3]	MSEC
		Cyl #5: FSI_q_cbdTotalAdj_v[4]	MSEC
		Cyl #6: FSI_q_cbdTotalAdj_v[5]	MSEC

152. Fuel Pressure Diagnostics (FPD)

Filtered_Engine_Speed	RPM	*Pressure Side Fuel Filter Diagnostics:*	
FSS_Total_Fueling	MG/STROKE	FPD_lp_DPAdapted_v	MBAR
Fueling_Control_State	---	FPD_p_FilterServiceCk_p	%
FSI_lp_FlFilterIn_v	MBAR	FPD_x_FilterCheckMiles_p	MI
Fuel_Pressure	PSI	*Gallery Pressure Diagnostics:*	
FSI_lp_Gallery_v	MBAR	FPD_lp_LowThreshold_c	MBAR
Fuel_Rail_Pressure	PSI	FPD_lp_HighThreshold_c	MBAR
PCC_lp_PressureError_v	MBAR	FPD_lp_LowCrankSupplyPrs_c	MBAR

153. Fuel Shut Off (FSO) Controls

Filtered_Engine_Speed	RPM	FSO_Command	---
FSS_Total_Fueling	MG/STROKE	FSO_p_PWMDutyCycle_v	%DC
Fueling_Control_State	---	FSO_s_DiagState_v	---
Fuel_Rail_Pressure	PSI	FSO_s_PWMState_v	---
		FSO_ct_Timer_v	SEC

154. Fuel System Fault Derate Handler (FDH)

Filtered_Engine_Speed	RPM	*Fault Derate Handler Reaction Calibrations:*	
FSI_q_totalFueling_v	MG/STROKE	FDH_x_CBDTrimLimReact_c	HEX
FSI_ca_mainSOI_v	CRANK_DEG	FDH_x_CylCutoutReact_c	HEX
Fueling_Control_State	---	FDH_x_EPSBackupIntrSyncReact_c	HEX
Fuel_Rail_Pressure	PSI	FDH_x_EPSBackupReact_c	HEX
Fuel_Pressure	PSI	FDH_x_EPSMainIntrSyncReact_c	HEX
Fuel_Temperature	DEG_F	FDH_x_EPSMainReact_c	HEX
EPS_Main_Sync_State	---	FDH_x_EPSPhaseReact_c	HEX
EPS_Backup_Sync_State	---	FDH_x_FSOHighElectReact_c	HEX
CTS_x_ActiveFlMask_v	HEX	FDH_x_FSOLowElectReact_c	HEX
		FDH_x_FSOMechStuckReact_c	HEX
FSSC Fault Derate Handler Parameters:		FDH_x_FilterPOORReact_c	HEX
FDH_x_ActiveReaction_v	HEX	FDH_x_FlPrsSenInRangeReact_c	HEX
FDH_q_megaDerate_c	MG/STROKE	FDH_x_FrontFlActImpReact_c	HEX
FDH_q_miniDerate_c	MG/STROKE	FDH_x_FrontFlActSevReact_c	HEX
FDH_q_normalDerate_c	MG/STROKE	FDH_x_FrontTmActImpReact_c	HEX
FDH_ca_SOIDerate_c	CRANK_DEG	FDH_x_FrontTmActSevReact_c	HEX
FDH_n_MinSpeedLimit_c	RPM	FDH_x_RearFlActImpReact_c	HEX
FDH_n_MaxSpeedLimit_c	RPM	FDH_x_RearFlActSevReact_c	HEX
FDH_n_DerateRate_c	RPM	FDH_x_RearTmActImpReact_c	HEX
		FDH_x_RearTmActSevReact_c	HEX
		FDH_x_GalleryPOORReact_c	HEX
		FDH_x_HiFlSupplyPReact_c	HEX
		FDH_x_LowFlSupplyPReact_c	HEX
		FDH_x_PrsFlFiltCloggReact_c	HEX
		FDH_x_PrsFlFiltMaintgRact_c	HEX
		FDH_x_VBattOORReact_c	HEX

155. CBD / ESP Based Unintended Fueling Diagnostics (CUFD)

Filtered_Engine_Speed	RPM	CUFD_s_AlgorithmEnable_c		---
FSS_Total_Fueling	MG/STROKE	CUFD_s_Enable_v		---
Fueling_Control_State	---	CUFD_s_State_v		---
Engine_State	---		CUFD_s_State_v = 0	Normal State
Fuel_Rail_Pressure	PSI		CUFD_s_State_v = 1	Diag. State
EPS_Main_Sync_State	---		CUFD_s_State_v = 2	Low Power State
EPS_Backup_Sync_State	---		CUFD_s_State_v = 3	Limphome State
E_Brake_Status	---	CUFD_s_FSOEnable_v		---
CTS_x_UserFlMask_c	HEX	CUFD_x_CylinderMask_v		HEX
FDH_x_CylinderMask_v	HEX	CUFD_x_AugDeltaAccel_v		---
FSI_x_ExtCylMask_v	HEX	CUFD_x_DeltaAccelThreshold_v		---

Legacy Information

156. Hard Starting / Startup and Overshoot

Time:	0.1 sec	Filtered_Engine_Speed	EPS_Main_Sync_State
Monitor		Total_Fueling	EPS_Backup_Sync_State
		Oil_Pressure	Fuel_Rail_Pressure
Time:	0.2 sec	Filtered_Engine_Speed	FTT_ti_BaseFlTTL_v
Monitor		Total_Fueling	Final_Timing
		Engine_State	EPS_Main_Sync_State
		Fueling_Control_State_Value	EPS_Backup_Sync_State

157. Cold Starting

Time:	0.5 sec	Filtered_Engine_Speed	Fuel_Rail_Press
Monitor		Total_Fueling	Battery_Volt
		Fueling_Control_State_Value	Charge_Tmptr
		Final_Timing	Coolant_Tmptr
		Final_Timing_State	FTT_ti_BaseFlTTL_v
		EPS_Main_Sync_State	FTT_ti_BaseTmTTL_v
		EPS_Backup_Sync_State	Reset_Count

158. Clutch Engagement / Idle Overshoot

Time:	0.1 sec	Filtered_Engine_Speed	
Monitor		Total_Fueling	
		Road_Speed	
Time:	0.2 sec	Filtered_Engine_Speed	Fueling_Control_State_Value
Monitor		Road_Speed	FTT_ti_BaseFlTTL_v
		Total_Fueling	Commanded_Throttle
Time:	0.4 sec	Filtered_Engine_Speed	Commanded_Throttle
Monitor		Road_Speed	Fueling_Control_State_Value
		Total_Fueling	OFC_Fuel_Limit
		Ndot_LSG	Sampled_Throttle_Raw
		FTT_ti_BaseFlTTL_v	System_Switch_Status

159. Throttle Control – Min / Max (Automotive Governor)

Make note of any tendency towards seat movement/chassis vibration, pedal events, etc. Is seat locked? Location of driver's foot. How is driver's foot touching the throttle pedal? Is the driver's heel firmly on the pedal or is it above pedal? Does the driver's heel slide along the cab floor?

Time:	0.1 sec	Filtered_Engine_Speed	Sampled_Throttle_Raw
Monitor		Commanded_Throttle	
		Total_Fueling	
Time:	0.2 sec	Filtered_Engine_Speed	Commanded_Throttle
Monitor		Sampled_Throttle_Raw	Boost_Pressure
		Total_Fueling	Road_Speed
		Fueling_Control_State_Value	
		Filtered_Gear_Ratio	
Time:	0.4 sec	Filtered_Engine_Speed	FTT_ti_BaseFlTTL_v
Monitor		Sampled_Throttle_Raw	Throttle_Range
		Total_Fueling	Auto_Zero
		Fueling_Control_State_Value	Ndot_Demand
		Commanded_Throttle	TQM_Final_Torque_Cmd
		Road_Speed	

160. Throttle Control – All Speed (VS) Governor

Make note of any tendency towards seat movement/chassis vibration, pedal events, etc. Is seat locked? Location of driver's foot. How is driver's foot touching the throttle pedal?

Time:	0.1 sec	Filtered_Engine_Speed	ASG_Throttle_Reference_RPM
Monitor		Sampled_Throttle_Raw	ASG_Reference_Speed
		Ndot_ASG	
Time:	0.2 sec	Filtered_Engine_Speed	Ndot_ASG
Monitor		Fueling_Control_State_Value	Ndot_Demand
		Sampled_Throttle_Raw	Road_Speed
		Commanded_Throttle	Commanded_Throttle
Time:	0.4 sec	Filtered_Engine_Speed	Boost_Pressure
Monitor		Sampled_Throttle_Raw	Fueling_Control_State_Value
		Ndot_ASG	FTT_ti_BaseFlTTL_v
		Total_Fueling	Ndot_Demand
		Commanded_Throttle	TQM_Final_Torque_Cmd
		Road_Speed	

161. Cruise Control / Road Speed / Geardown Governor Behavior

Time:	0.1 sec	Filtered_Engine_Speed	
Monitor		Total_Fueling	
		Road_Speed	
Time:	0.2 sec	Filtered_Engine_Speed	Road_Speed
Monitor		Fueling_Control_State_Value	Ndot_Demand
		Adjusted_User_Fueling_State	Net_Engine_Torque
		Total_Fueling	CC_Error
Time:	0.5 sec	Filtered_Engine_Speed	Fueling_Control_State_Value
Monitor		CC_Error	Ndot_Net_Torque_Cmd_State
		Ndot_Cruise_Control	Commanded_Throttle
		Ndot_Demand	Road_Speed
		Net_Engine_Torque	Boost_Pressure
		Total_Fueling	Cruise_Max_Road_Speed
		System_Switch_Status	Cruise_Control_Reference_Speed

Cruise Control Setting Switch Diagnostics

Time:	0.2 sec	Filtered_Engine_Speed	Total_Fueling
Monitor		Fueling_Control_State_Value	System_Switch_Status
		Cruise_Control_Reference_Speed	Road_Speed

162. Cruise Control With Engine Brakes

Time:	0.1 sec	Filtered_Engine_Speed	
Monitor		Total_Fueling	
		Road_Speed	
Time:	0.2 sec	Filtered_Engine_Speed	Road_Speed
Monitor		Fueling_Control_State_Value	Ndot_Demand
		Adjusted_User_Fueling_State	Net_Engine_Torque
		Total_Fueling	CC_Error
Time:	0.5 sec	Filtered_Engine_Speed	Fueling_Control_State_Value
Monitor		CC_Error	Ndot_Net_Torque_Cmd_State
		Charge_Press	Commanded_Throttle
		Exhaust_Press	Road_Speed
		Net_Engine_Torque	Charge_Flow
		Total_Fueling	Cruise_Max_Road_Speed
		System_Switch_Status	Cruise_Control_Reference_Speed

163. Cruise Control With AutoResume

Time:	0.2 sec	Filtered_Engine_Speed	Road_Speed
Monitor		Total_Fueling	Cruise_Control_Status
		Fueling_Control_State_Value	CC_Error
Time:	0.4 sec	Ndot_Net_Torque_Cmd_State	Cruise_Control_Reference_Speed
Monitor		Cruise_Droop	CC_Error
		Total_Fueling	System_Switch_Status
		Fueling_Control_State_Value	Cruise_Control_Status
		Road_Speed	Cruise_Command_Mode

164. Engine Braking

Time:	0.2 sec	Filtered_Engine_Speed	Commanded_Throttle
Monitor		E_Brake_Status	Road_Speed
		Boost_Pressure	Total_Fueling
		Net_Engine_Torque	
Time:	0.4 sec	Filtered_Engine_Speed	Commanded_Throttle
Monitor		E_Brake_Status	Fueling_Control_State_Value
		EB_Driver_Level	Boost_Pressure
		Total_Fueling	Road_Speed
		Net_Engine_Torque	Ambient_Air_Press
Time:	0.5 sec	Filtered_Engine_Speed	Road_Speed
Monitor		E_Brake_Status	Charge_Tmptr
		EB_Driver_Level	System_Switch_Status
		Total_Fueling	Ambient_Air_Press
		Net_Engine_Torque	Coolant_Tmptr
		Commanded_Throttle	Oil_Press
		Fueling_Control_State_Value	Exhaust_Press
		Boost_Pressure	Charge_Flow

165. Low Power – Road Speed Governor

Time:	0.1 sec	Filtered_Engine_Speed	
Monitor		Total_Fueling	
		Road_Speed	
Time:	0.2 sec	Filtered_Engine_Speed	Total_Fueling
Monitor		Ndot_Net_Torque_Cmd_State	Commanded_Throttle
		Boost_Pressure	Road_Speed
Time:	0.4 sec	Filtered_Engine_Speed	Ndot_RSG
Monitor		Throttle_100_Torque	OFC_Fuel_Limit
		Fueling_Control_State_Value	OFC_EGR_Disable
		Total_Fueling	Road_Speed
		Commanded_Throttle	Boost_Pressure
		Ndot_Demand	

166. Low Power – Geardown Protection

Time:	0.1 sec	Filtered_Engine_Speed	
Monitor		Total_Fueling	
		Road_Speed	
Time:	0.2 sec	Filtered_Engine_Speed	Total_Fueling
Monitor		RSG_Reference_Speed	Commanded_Throttle
		Boost_Pressure	Road_Speed
		Gear_Down_Active	
Time:	0.4 sec	Filtered_Engine_Speed	Commanded_Throttle
Monitor		Cruise_RSG_Road_Speed	Filtered_Gear_Ratio
		Total_Fueling	User_Filtered_Gear_Ratio
		Fueling_Control_State_Value	Gear_Down_Gear_Ratio
		Ndot_Net_Torque_Cmd_State	Gear_Down_Active

167. Low Power – Boost Response Test

Time:	0.1 sec	Filtered_Engine_Speed	
Monitor		Boost_Pressure	
		Commanded_Throttle	
Time:	0.2 sec	Filtered_Engine_Speed	Net_Engine_Torque
Monitor		Sampled_Throttle_Raw	Commanded_Throttle
		Boost_Pressure	Road_Speed
		Total_Fueling	VGT_Duty_Cycle
Time:	0.3 sec	Filtered_Engine_Speed	Final_Timing
Monitor		Fueling_Control_State_Value	Commanded_Throttle
		Total_Fueling	Road_Speed
		Alpha	Boost_Pressure
		Final_Timing_State	VGT_Duty_Cycle
			Net_Engine_Torque
Time:	0.5 sec	Filtered_Engine_Speed	Boost_Pressure
Monitor		Fueling_Control_State_Value	Ambient_Air_Press
		Total_Fueling	EGR_Position
		Alpha	VGT_Duty_Cycle
		Final_Timing_State	Filtered_Turbo_Speed
		Final_Timing	OFC_Fuel_Limit
		Commanded_Throttle	Fuel_Rail_Press
		Road_Speed	PCC_lp_PressureError_v

168. Throttle Characterization / Idle Validation Switches

Make note of throttle pedal make and model.
Slowly ramp throttle from fully released to fully depressed to fully released – especially near 0 and 100 % throttle.
Engine speed data is useful in evaluating throttle deadband (EM00168).

Time:	0.4 sec	Filtered_Engine_Speed	Sampled_Throttle_Raw
Monitor		Auto_Zero	Throttle_Status
		Throttle_Min	Total_Fueling
		Sampled_Throttle	Fueling_Control_State
		Commanded_Throttle	System_Switch_Status
		FTT_ti_BaseFlTTL_v	System_Switch_Status_2

169. Low Idle Stability / Rough Idle

Record Oil_Temperature, Coolant_Temperature, Intake_Manifold_Temperature

Time:	0.1 sec	Filtered_Engine_Speed	
Monitor		Total_Fueling	
		Final_Timing	
Time:	0.2 sec	Filtered_Engine_Speed	FTT_ti_BaseFlTTL_v
Monitor		Total_Fueling	Fueling_Control_State_Value
		Final_Timing	Final_Timing_State
Time:	0.5 sec	Filtered_Engine_Speed	LSG_Breakpoint_Speed
Monitor		Total_Fueling	CBD_s_adjusting_v
		Final_Timing	CBD_s_error_v
		FTT_ti_BaseFlTTL_v	LSG_Error
		FTT_ti_BaseTmTTL_v	Ndot_LSG
		EPS_Engine_Speed	Ndot_Demand
		Fuel_Rail_Press	Ndot_Error
		PCC_lp_PressureError_v	

170. PTO Response / Stability

Record Oil_Temperature, Coolant_Temperature, Intake_Manifold_Temperature
Ramp engine speed from idle to PTO speed via SET or RESUME switch.

Time:	0.1 sec	Filtered_Engine_Speed	
Monitor		Total_Fueling	
		Final_Timing	
Time:	0.3 sec	Filtered_Engine_Speed	Ndot_PTO
Monitor		Total_Fueling	Ndot_Demand
		PTO_State	Fueling_Control_State_Value
		PTO_Status	PTO_Error
			System_Switch_Status

171. No Load Friction / Light Load Throttle Control

Take two sets of data: One with bare engine and one with fan control locked ON (optional).
Gently activate throttle to slowly ramp engine speed from low idle to high idle (30 second ramp).

Time:	0.2 sec	Filtered_Engine_Speed	Total_Fueling
Monitor		Sampled_Throttle_Raw	Commanded_Throttle
		Fueling_Control_State_Value	Final_Timing
		Boost_Pressure	
Time:	0.3 sec	Filtered_Engine_Speed	Oil_Tmptr
Monitor		Sampled_Throttle_Raw	No_Load_Torque
		Fueling_Control_State_Value	Net_Engine_Torque
		Total_Fueling	Final_Timing
		Commanded_Throttle	Boost_Pressure
			FTT_ti_BaseFlTTL_v

172. Turbo Surge Conditions

Time:	0.1 sec	Filtered_Engine_Speed	Commanded_Throttle
Monitor		Boost_Pressure	VGT_Duty_Cycle
Time:	0.2 sec	Filtered_Engine_Speed	Total_Fueling
Monitor		Boost_Pressure	System_Switch_Status
		Commanded_Throttle	Ambient_Air_Press
			VGT_Duty_Cycle
Time:	0.5 sec	Filtered_Engine_Speed	VGT_Duty_Cycle
		Boost_Pressure	Charge_Flow
		Commanded_Throttle	CHL_MCF_Cmd
		Total_Fueling	EGR_Fraction
		System_Switch_Status	CHL_EGR_Frac_Cmd
		Ambient_Air_Press	EGR_Position
		Charge_Tmptr	EGR_Delta_Press
		Road_Speed	Filtered_Turbo_Speed

173. ESP Performance (Hill Climbing)

Time:	0.4 sec	Filtered_Engine_Speed	Road_Speed
Monitor		Boost_Pressure	User_Filtered_Gear_Ratio
		Commanded_Throttle	ESP_Tau
		Total_Fueling	ESP_Tau_State
		System_Switch_Status	ESP_Cruise_Timer
		Fueling_Control_State_Value	ESP_Throttle_Timer_1
		ESP_Learned_Speed	

174. VSS Anti-Tampering

Make note of Calibration_Version_Number (Application Software Phase)

Time:	0.3 sec	Filtered_Engine_Speed	Throttle_Status
Monitor	F/C 241	Road_Speed	System_Switch_Status
		Total_Fueling	VSS_Tamper_State
		Fueling_Control_State_Value	
Time:	0.4 sec	Filtered_Engine_Speed	User_Filtered_Gear_Ratio
Monitor	F/C 242	J1587_Percent_Load	VSS_Tamper_State
		Total_Fueling	VSS_Tampering_Error
		Fueling_Control_State	

175. Acceleration Noise Control

Record Coolant_Temperature during testing.

Time:	0.3 sec	Filtered_Engine_Speed	Road_Speed
Monitor		Total_Fueling	ANC_Fuel_Limit_Status
		Commanded_Throttle	ANC_Timing_Limit_Status
		Fueling_Control_State_Value	Ndot_ANC
Time:	0.4 sec	Filtered_Engine_Speed	Road_Speed
Monitor		Total_Fueling	ANC_Fuel_Limit_Status
		Commanded_Throttle	ANC_Timing_Limit_Status
		Fueling_Control_State_Value	Ndot_ANC
		Final_Timing	Ndot_Demand
		Effective_Gear_Ratio	OFC_Fuel_Limit

176. Cold Temperature Stumble / IMT SOI Advance Control (White Smoke)

Rapid accelerations under free-engine conditions may lead to white smoke and/or poor acceleration. A combination of data Is recommended. The first set of data serves as the baseline to engine conditions at idle prior to the second data set. The second set of data captures various engine conditions and temperatures as the engine warms up.
Record DATA 1 prior to DATA 2, then record DATA 1 again to document engine conditions as engine conditions change.

Time:	0.3 sec	Filtered_Engine_Speed	Oil_Tmptr
Monitor	DATA 1	Ambient_Air_Press	Charge_Tmptr
		Coolant_Tmptr	Boost_Pressure
		Final_Timing	EGR_Fraction
Time:	0.3 sec	Filtered_Engine_Speed	Final_Timing
Monitor	DATA 2	Total_Fueling	Final_Timing_State
		Fueling_Control_State_Value	Boost_Pressure
		EGR_Fraction	

177. Road Speed Governor / Cruise Control Hiccup / Miss

Try and log these different combinations of parameters. Logging at any slower rate with more parameters significantly reduces the likelihood of capturing the event. If necessary, utilize Internal Data Logger with parameters listed.

Time:	0.1 sec	Filtered_Engine_Speed
Monitor		Out_Of_Gear
		Road_Speed
Time:	0.1 sec	Filtered_Engine_Speed
Monitor		Total_Fueling
		Fueling_Control_State_Value
Time:	0.1 sec	Filtered_Engine_Speed
Monitor		Fueling_Control_State_Value
		Road_Speed

178. High Speed Governor Stability

These parameters can be used for logging most HSG issues, Transient and Steady State.

Time:	0.3 sec	Filtered_Engine_Speed	HSG_Reference_Speed
Monitor		Total_Fueling	Ndot_HSG
		Fueling_Control_State_Value	Ndot_Demand
		HSG_Ref_Speed_State	Ndot_Error
		HSG_Droop_Speed	
Time:	0.5 sec	Filtered_Engine_Speed	FTT_ti_BaseFlTTL_v
Monitor		Total_Fueling	Zero_Vss_Derate_RPM
		Fueling_Control_State_Value	Ndot_Demand
		Adjusted_User_Fueling	Ndot_HSG
		Adjusted_User_Fueling_State	Ndot_Error
		HSG_Reference_Speed	Ndot_Net_Torque_Cmd
		HSG_Ref_Speed_State	Net_Engine_Torque
		HSG_Droop_Speed	

179. Stumble During Rapid Accel

OFC (Oxygen-Fuel Control) related stumble or poor acceleration.

Time:	0.1 sec	Filtered_Engine_Speed	
Monitor		Total_Fueling	
		OFC_Fuel_Limit	
Time:	0.4 sec	Filtered_Engine_Speed	Charge_Flow
Monitor		Total_Fueling	Total_O2_in_Cylinder
		OFC_Fuel_Limit	Final_Timing
		OFC_Limited	Final_Timing_State
		OFC_Equiv_Ratio_Limit	Alpha
			CBR_Chi_Value

180. Ambient Air Pressure Sensor – Poor Engine Performance

Time:	0.3 sec	Filtered_Engine_Speed	Ambient_Air_Press
Monitor		Total_Fueling	Boost_Pressure
		Fueling_Control_State_Value	Charge_Tmptr
		Air_Pressure_Sensor	
		Air_Pressure_Sensor_Raw	

181. Stationary Test – Brake Activation Delay

Use with manual throttle event. Cycle throttle pedal. Engine speed snap throttles from High idle to low idle with Engine Brake switch ON. Collect data at cold oil temperature And at every 20 deg F as engine warms up.

Time:	0.1 sec	Filtered_Engine_Speed	
Monitor		Commanded_Throttle	
		Fueling_Control_State_Value	
Time:	0.2 sec	Filtered_Engine_Speed	Total_Fueling
Monitor		Commanded_Throttle	EB_Driver_Level
		Fueling_Control_State_Value	Oil_Tmptr

182. Fan Drive Activation

Time:	0.3 sec	Filtered_Engine_Speed	Coolant_Tmptr
Monitor		Total_Fueling	Charge_Tmptr
		Fan_Drive_State	System_Switch_Status
			System_Switch_Status_2
Time:	0.5 sec	Filtered_Engine_Speed	Fan_Manual_Input_Request
Monitor		Total_Fueling	Fan_Air_Conditioner_Request
		Fueling_Control_State_Value	Fan_Coolant_Temp_Request
		Fan_Drive_State	Fan_Intake_Manifold_Temp_Request
		Air_Conditioner_Pressure_Switch	Fan_Clutch_Status_1
		Manual_Fan_Input	Fan_Request
		Coolant_Tmptr	
		Charge_Tmptr	

183. ECM Trip Information / Fuel Economy Accuracy

Record Odometer and Hubometer Miles at start and end of trip. Top-Off fuel tank at start and end of trip
For comparison of fill gallons / miles against data-logged ECM data at start and end of trip.
Calculate ECM MPG accuracy based on actual (fill/odom/hubo) versus ECM.
Log data at state line crossings or freeway mile markers for reference to Trip_Distance.
Confidence in results increases with long trips. If possible, trips of sufficient length to require multiple Fuel fills between start and end.

Time:	1.0 sec	Trip_Distance	Trip_PTO_Fuel_Used
Monitor		Trip_CC_Distance	Trip_Drive_Fuel_Used
		Trip_GD_Distance	Trip_Time
		Trip_TG_Distance	Trip_Idle_Time
		Trip_ESP_Distance	Trip_PTO_Time
		Trip_RSG_Distance	Total_Distance
		Trip_Fuel_Used	Total_Fuel_Usage
		Trip_Idle_Fuel_Used	Trip_Average_Load

184. Datalink Torque Calculations

Time:	0.3 sec	Filtered_Engine_Speed	Filtered_Gear_Ratio
Monitor		Total_Fueling	Jcomm_Drivers_Demand_Ind_Torque
		Fueling_Control_State_Value	J1939_Fuel_Rate
		J1587_Percent_Load	Road_Speed
		J1587_Fuel_Rate	

185. Integrated Centinel (CORS)

Time:	0.3 sec	CORS_Burn_Valve_Command	Trip_Average_Fuel_Rate
Monitor		Trip_Average_Load	J1587_Fuel_Rate
		Trip_Drive_Distance	Filtered_Engine_Speed
		Trip_Fuel_Used	Total_Fueling

186. Starter Lockout

Time:	0.2 sec	Filtered_Engine_Speed	Commanded_Throttle
Monitor		Total_Fueling	Engine_State
		Fueling_Control_State_Value	Starter_Lockout_Driver

187. Fan Control

Time:	0.5 sec	Filtered_Engine_Speed	Coolant_Tmptr
Monitor		Total_Fueling	Charge_Tmptr
		Fueling_Control_State_Value	Fan_Air_Conditioner_Request
		Fan_Drive_State	Fan_Coolant_Temp_Request
		System_Switch_Status	Fan_Intake_Manifold_Temp_Request
		System_Switch_Status_2	Fan_EB_Request
		Fan_Clutch_Status_1	Fan_Manual_Input_Request

188. Anti-Theft

Time:	0.1 sec	Filtered_Engine_Speed
Monitor		Engine_State
		Anti_Theft_State

189. Cab Switchable Governor

Time:	0.2 sec	Commanded_Throttle	No_Load_Torque
Monitor		Total_Fueling	User_Selected_Throttle_Control
		Ndot_Net_Torque_Cmd	Filtered_Engine_Speed
Time:	0.3 sec	Filtered_Engine_Speed	No_Load_Torque
Monitor		Total_Fueling	Commanded_Throttle
		Fueling_Control_State_Value	Ndot_ASG
		User_Selected_Throttle_Control	Ndot_Four_D
		Ndot_Net_Torque_Cmd	Ndot_Demand

190. Driver Reward

Time:	0.1 sec	Trip_Average_Fuel_Economy	
Monitor		DR_RSG_CC_Delta	
		DR_ESP_Delta	
Time:	0.2 sec	Trip_Average_Fuel_Economy	Max_Road_Speed
Monitor		DR_RSG_CC_Delta	Cruise_Max_Road_Speed
		DR_ESP_Delta	ESP_Tau_State
Time:	0.3 sec	Trip_Average_Fuel_Economy	ESP_Tau_State
Monitor		DR_RSG_CC_Delta	Trip_Idle_Time
		DR_ESP_Delta	Trip_Short_Stop_Idle_Time
		Max_Road_Speed	Trip_PTO_Time
		Cruise_Max_Road_Speed	
Time:	0.4 sec	Trip_Average_Fuel_Economy	Trip_Idle_Time
Monitor		DR_RSG_CC_Delta	Trip_Short_Stop_Idle_Time
		DR_ESP_Delta	Trip_PTO_Time
		Max_Road_Speed	Trip_Time
		Cruise_Max_Road_Speed	Driver_Reward_State
		ESP_Tau_State	Road_Speed
		NOTE THE FOLLOWING VALUES:	
		DR_ESP_Reward1	DR_RSG_CC_Reward1
		DR_ESP_Reward2	DR_RSG_CC_Reward2
		DR_ESP_Reward3	DR_RSG_CC_Reward3
		DR_ESP_Reward4	DR_RSG_CC_Reward4
		DR_MPG_Threshold1	DR_ZVS_Percent1
		DR_MPG_Threshold2	DR_ZVS_Percent2
		DR_MPG_Threshold3	DR_ZVS_Percent3
		DR_CC_RSG_Both_Option	Cruise_Max_Road_Speed_Trim
			Max_Road_Speed_Trim

191. FSSC: Cylinder Cut-Out

Cylinder Trim Selection (CTS) determines the final actuator pulse times and crank angle placement. CTS algorithm applies single cylinder on-time trims and reconciles cylinder cut-outs. CTS algorithm also Contains important engineering overrides. CTS can be used to disable cylinders for troubleshooting.

Time:	0.2 sec	Filtered_Engine_Speed	
Monitor		Total_Fueling	
		Fueling_Control_State_Value	
		CTS_x_ActiveFlMask_v	
		FTT_ti_BaseFlTTL_v	
		FTT_ti_BaseTmTTL_v	
		OVERRIDE CYLINDER ON-TIMES:	
		CTS_x_UserFlMask_c	Disable #1 Cyl – set value to 003E hex
			Disable #6 Cyl – set value to 001F hex
			Disable Front Bank – set value to 0038 hex
			Disable Rear Bank – set value to 0007 hex
		CTS_ti_FlTrim_c[0-5]	CTS_ti_FlTrim_c[0] = 0.5 msec – add 0.5 msec on-time to #1 Cyl
			CTS_ti_FlTrim_c[5] = -0.5 msec – remove 0.5 msec on-time to #6 Cyl
		NOTE:	
		CTS_x_ActiveFlMask_v	Hex value which indicates active cylinders. Bits 0-5 correspond to Cylinders 1-6. Bit value of 1 indicates cylinder is enabled. CTS_x_ActiveFlMask_c = 003F – all 6 cylinders enabled

192. Powertrain Protection

Time:	0.1 sec	PTP_Torque_Output	
Monitor		Net_Engine_Torque	
		Fueling_Control_State_Value	
Time:	0.2 sec	PTP_Torque_Output	Adjusted_User_Fueling_State
Monitor		Net_Engine_Torque	Total_Fueling
		Fueling_Control_State	
Time:	0.4 sec	PTP_Torque_Output	Total_Fueling
Monitor		Net_Engine_Torque	PTP_Switched_Input
		Throttle_100_Torque	Ndot_Demand
		Fueling_Control_State_Value	Ndot_Powertrain
		Filtered_Gear_Ratio	Ndot_Error
		Ndot_Net_Torque_Cmd	

193. Smart Road Speed Governor

Time:	0.2 sec	Filtered_Engine_Speed	Max_Road_Speed
Monitor		Total_Fueling	System_Switch_Status
		Fueling_Control_State	SR_Reference_Speed
Time:	0.4 sec	Filtered_Engine_Speed	System_Switch_Status
Monitor		Total_Fueling	Cruise_Control_Accel_Switch
		Fueling_Control_State_Value	Cruise_Control_Coast_Switch
		SR_Reference_Speed	Cruise_Control_On_Switch
		Max_Road_Speed	
		Road_Speed	

194. J1939 Devices / Eaton Autoshift

Time:	0.5 sec	Filtered_Engine_Speed	Jcomm_Engine_Control_Device_Indicator
Monitor		Total_Fueling	E_Brake_Status
		Fueling_Control_State_Value	HSG_Reference_Speed
		Jcomm_Engine_Control_Mode	Jcomm_High_Idle_Override
		Jcomm_Reference_RPM	Commanded_Throttle
		Jcomm_Reference_Engine_Torque	Road_Speed
		Jcomm_Engine_Speed_Limit_RPM	Jcomm_Retarder_Torque_Command
		Jcomm_Retarder_Control_Mode	Jcomm_Engine_Torque_Command
		E_Brake_Status	

195. Highway Cruise Strategy Data Collection

Also record:
Estimate of Gross Vehicle Combined weight
Route start location
Ambient conditions: Ambient_Air_Tmptr, Ambient_Air_Press, Rel Humidity
Note odometer at start and end of datalog
Note route description during test, note any major events during test

Time:	1.0 sec	Filtered_Engine_Speed	Alpha_Fuel_Rate
Monitor		Road_Speed	Alpha_AFC_Timer
		Commanded_Throttle	Alpha_LSG_Timer
		Total_Fueling	Alpha_Governor
		Fueling_Control_State_Value	Current_Torque_Output
		Delta_Fuel_Trip	Net_Engine_Torque
		Alpha	J1587_Percent_Load
		Final_Timing	System_Switch_Status
		Final_Timing_State	

196. Duty Cycle Logging of Route

Time:	0.3 sec	Filtered_Engine_Speed	Net_Engine_Torque
Monitor		Road_Speed	Final_Timing
		Boost_Pressure	Total_Distance
		Total_Fueling	
		Fueling_Control_State_Value	
		Commanded_Throttle	
Time:	0.5 sec	Filtered_Engine_Speed	CBR_Chi_Value
Monitor		Total_Fueling	Oil_Tmptr –OR- Coolant_Tmptr
		Fueling_Control_State_Value	EB_Driver_Level
		Final_Timing	EGR_Valve_Delta_Press
		Net_Engine_Torque	Charge_Press
		Road_Speed	Charge_Tmptr
		Commanded_Throttle	EGR_Position
		Total_Distance	VGT_Duty_Cycle

CM870 ENGINEERING STATES

** NOTE: Fueling_Control_State represents the Alpha Value while Fueling_Control_State_Value represents the Enumeration **

ENGINE TORQUE / FUEL COMMAND ENGINEERING STATES:

Fueling_Control_State
Fueling_Control_State_Value
TQM_Net_Engine_Torque_State
TQM_Machine_Torque_Limit_State
TQM_Engine_Torque_Limit_State
Desired_User_Fueling_State
Adjusted_User_Fueling_State
Ndot_Net_Torque_Cmd_State
CBR_Fuel_Ref_State

State	Alpha Value	Enumeration
NOT_SET	NOT_SET	0
FUELING_JCOMM_TORQUE_STATE	JCOMTORQ	1
FUELING_JCOMM_SPEED_STATE	JCOMSPED	2
FUELING_PROGRESSIVE_SHIFT_SPEED_STATE	PSSPEED	3
FUELING_PTO_STATE	PTO	4
FUELING_USER_COMMAND_STATE	USERCOMD	5
FUELING_LIMP_HOME_STATE	LIMPHOME	6
FUELING_ASG_THROTTLE_STATE	ASGTHROT	7
FUELING_FOUR_DIMENSION_STATE	FOUR_D	8
FUELING_CRUISE_CONTROL_STATE	CRUISE	9
FUELING_RSG_STATE	RSG	10
FUELING_LSG_STATE	LSG	11
FUELING_HSG_STATE	HSG	12
FUELING_TORQUE_DERATE_OVERRIDE_STATE	TRQDROVR	13
FUELING_LOW_GEAR_STATE	LOWGEAR	14
FUELING_ALTITUDE_DERATE_STATE	ALTDERAT	15
FUELING_OFC_DERATE_STATE	OFCDERAT	16
FUELING_ANC_DERATE_STATE	ANCDERAT	17
FUELING_ENGINE_PROTECT_STATE	EPF	18
FUELING_MAXIMUM_THROTTLE_STATE	MAXTHROT	19
FUELING_JCOMM_TORQUE_DERATE_STATE	JCTRQDER	20
FUELING_OUT_OF_GEAR_STATE	OUTOGEAR	21
FUELING_CRANK_STATE	CRANK	22
FUELING_OVERRIDE_STATE	OVERRIDE	23
FUELING_ENGINE_BRAKE_STATE	ENGBRAKE	24
FUELING_OVERSPEED_STATE	OVERSPED	25
FUELING_STOP_STATE	STOP	26
FUELING_SHUTDOWN_STATE	SHUTDOWN	27
FUELING_FSS_DERATE_STATE	FSSDERAT	28
FUELING_EPF_DERATE_STATE	EPFDERAT	29
FUELING_ASG_APPLICATION_STATE	ASG_APPL	30
FUELING_ALTERNATE_TORQUE_STATE	ALT_TORQ	31
FUELING_MS_OVERRIDE_STATE	MSOVRIDE	32
FUELING_ENGINE_STARTUP_OIL_LIMIT	ESUOILLM	33
FUELING_PTO_DERATE_STATE	PTODERAT	34
FUELING_TORQUE_CONTROL_STATE	TORQCTRL	35
FUELING_PTP_DERATE_STATE	PTPDERAT	36
FUELING_T2_SPEED_STATE	T2SPD	37
FUELING_T2_TORQUE_STATE	T2TORQ	38
FUELING_T2_DERATE_STATE	T2DERAT	39
FUELING_NO_DERATE_STATE	NODERAT	40
FUELING_ANTI_THEFT_DERATE_STATE	ATDERAT	41
FUELING_PARTIAL_THROTTLE_LIMIT_STATE	PTTHLM	42
SS_AMBIENT_DERATE_STATE	SSAMBTDR	43
TRANSIENT_COOLANT_DERATE_STATE	TSCOOLDR	44
FUELING_RMG_STATE	RMG	45
FUELING_AIR_DENSITY_LIMIT_STATE		46
FUELING_CHI_FUEL_LIMIT_STATE	CHILIMIT	47
FUELING_TFC_DERATE_STATE	TFCDERAT	48
FUELING_CBR_GROSS_FUEL_OVERRIDE_STATE	CBRGROSS	49
FUELING_CHM_DERATE_STATE	CHMDERAT	50
FUELING_JCOMM_PTP_DERATE_STATE	JCOMMPTP	51

ENGINE OPERATING CONDITION (ALPHA/CHI) STATES:

Engine_State

State	Alpha Value	Enumeration
Engine_Stop_State	STOP	1
Engine_Crank_State	CRANK	2
Engine_Run_State	RUN	3
Engine_Brake_State	ENGBRAKE	4
Engine_Overspeed_State	OVERSPED	5
Engine_Jumpstart_State	JUMPSTRT	6
Engine_Crank_Reentry_State	REENTRY	7
Engine_Shutdown_State	SHUTDOWN	8

Alpha

CBR_Alpha

State	Alpha Value	Enumeration
Urban Mode / Transient	URBAN	0
On-Highway / Steady State	OPEN_ROAD	1

Alpha_State

State	Alpha Value	Enumeration
Base	BASE	0
User	USER	1
Altitude_Derate	ALTITUDE	2
Engine_Protection	EPF	3
Slave_State	SLAVE	4
ESP_Alpha	ESP	5

CBR_Chi_Value

State	Alpha Value	Enumeration
Chi 1: Steady State	CHI 1	1
Chi 2: AECD Region II	CHI 2	2
Chi 3: AECD Region III	CHI 3	3
Chi 4: EGR Off	CHI 4	4

CBR_Chi_Source

State	Alpha Value	Enumeration
CBR_DENSITY_CHI	DENS_CHI	1
CBR_EXHAUST_CHI	EXH_CHI	2
CBR_COOLANT_CHI	COOL_CHI	3
CBR_EGR_OFF_CHI	EGR_OFF_CHI	10
USER_OVERRIDE_SOURCE	OVERRIDE	11
CBR_FULL_USER_OVERRIDE_CHI	FULL_OD	12
CBR_SINGLE_USER_OVERRIDE_CHI	SINGLE_OD	13
CBR_PROTECTION_CHI	PROTECT_CHI	14

ESP_Tau_State

State	Alpha Value	Enumeration
Normal	NORMAL	0
Reverse	REVERSE	1
Steep Grade	STEEP_GRADE	2

EMMISION MANAGER AECD STATES:

EMM_AECD_State

State	Decimal Value	Bit Mask
Emission Protection	0	None
Air Handling System Protection	1	Bit 0
Extreme Ambient Overheat Protection	2	Bit 1
Condensation Protection	4	Bit 2
White Smoke / Misfire Protection	8	Bit 3
Extended Idle & PTO Protection	16	Bit 4
Engine Starting and Warmup Protection	32	Bit 5
Engine Protection	64	Bit 6
Diagnostic Procedures	128	Bit 7

EMISSION MANAGER PROTECTION STATES:

EMM_Protection_State

State	Decimal Value	Bit Mask
Normal Operation	0	None
Cranking	1	Bit 0
Normal Shutdown	2	Bit 1
Minor Engine Protection	4	Bit 2
Major Engine Protection	8	Bit 3
Emergency Shutdown	16	Bit 4
Wet Stack Protection	32	Bit 5
Coolant Advance	64	Bit 6
EGR Off Allowed	128	Bit 7
EGR System Failure	256	Bit 8
Cylinder Pressure Limit	512	Bit 9

1 = EMM STATE ACTIVE							
0 = EMM STATE NOT ACTIVE							
0000 = 0	0001 = 1	0010 = 2	0011 = 3	0100 = 4	0101 = 5	0110 = 6	0111 = 7
1000 = 8	1001 = 9	1010 = 10	1011 = 11	1100 = 12	1101 = 13	1110 = 14	1111 = 15

Converting DECIMAL to BINARY:
Divide the DECIMAL value by 2, and keep dividing the remainder by 2 until you reach a value of 1. Integer values are only used, so 1 divided by 2 becomes 0 with a remainder of 1. The combined remainders become the BINARY equivalent. Example:

512/2 = 256	remainder	0	BIT 0	87/2 = 43	remainder	1	BIT 0
256/2 = 128	remainder	0	BIT 1	43/2 = 21	remainder	1	BIT 1
128/2 = 64	remainder	0	BIT 2	21/2 = 10	remainder	1	BIT 2
64/2 = 32	remainder	0	BIT 3	10/2 = 5	remainder	0	BIT 3
32/2 = 16	remainder	0	BIT 4	5/2 = 2	remainder	1	BIT 4
16/2 = 8	remainder	0	BIT 5	2/2 = 1	remainder	0	BIT 5
8/2 = 4	remainder	0	BIT 6	1/2 = 0	remainder	1	BIT 6
4/2 = 2	remainder	0	BIT 7				
2/2 = 1	remainder	0	BIT 8				
1/2 = 0	remainder	1	BIT 9				

The BINARY equivalent of 512 is 0010 0000 0000

The BINARY equivalent of 87 is 0101 0111

EGR VALVE CONTROLLER STATES:

EGA_Control_State

State	Alpha Value	Enumeration
Closed_Loop	CLOSLOOP	0
Zero_Hold	ZEROHOLD	1
User_Override	USEROVER	2
Diagnostic_PWM_Override	DIAGOVER	3
PWM_Disabled	PWMDISAB	4

ENGINE SOI TIMING COMMAND ENGINEERING STATES:

Final_Timing_State
SOI_State
CBA_SOI_State

State	Alpha Value	Enumeration
Four_D_Timing_State	FOUR_D	0
Wet_Stack_Timing	WETSTACK	1
User_Commanded_Timing	USERCOMD	2
ANC_Timing	ANC	3
Max_Timing	MAX	4
Crank_Advance	CRANK	5
E_Brake_Timing	ENGBRAKE	6
User_Override_Timing	USEROVRD	7
Stopped_Timing	STOP	8
Overspeed_Timing	OVERSPED	9
Shutdown_Timing	SHUTDOWN	10
Misfire_Timing_Limit	MISFIRE	11
MS_Override_Timing	MSOVRIDE	12
Wet_Stack_Coolant_Timing	WTSTCOOL	13
Coolant_SOI_Advance_State	COOL_SOI	14
IMT_SOI_Advance_State	IMT_SOI	15
Ambient_Air_Pressure_SOI_Advance_State	AMB_SOI	16
CBR_SOI_Ref_State	CBR_SOI	17
E_Brake_Timing_State	EBRAKETM	18
Max_Timing_State	MAXTMST	19
Min_Timing_State	MINTMST	20

Final_Timing_Incr_State

State	Alpha Value	Enumeration
Timing_Incr_4_D	[NOT USED]	0
Timing_Incr_Coolant_Adv	[NOT USED]	1
AFC Timing Incr	AFC_INCR	2
Timing_Incr_Cylinder_Press	CYL_INCR	3
User Incr Mask	USER_INCR	4
CBO_Adjust	CBO_ADJ	5
OFC_Alpha0_Incr	OFC_INCR	6
Timing Incr Coolant Timing	COOL_INCR	7

HSG REFERENCE SPEED STATES:

HSG_Ref_Speed_State

State	Alpha Value	Enumeration
HSG_Injector_Fault_State	INJ_FAULT	1
HSG_Zero_VSS_State	ZERO_VSS	2
HSG_ANC_Derate_State	ANC_DER	3
HSG_VSS_Tamper_State	VSS_TAMP	4
HSG_Engine_Protection_State	ENG_PROT	5
HSG_Breakpoint_State	BREAKPOINT	6
HSG_FSS_Derate_State	FSS_DER	7
HSG_Jcomm_Override_State	JCOMM_OVR	8
HSG_Jcomm_Limit_State	JCOMM_LIM	9
HSG_TSG_Default_Engine_Speed_State	TSG_DEF	10
HSG_PTO_Throttle_Override_State	PTO_THROT	11
HSG_Alt_Breakpoint_State	ALT_BREAKPT	12

HSG_Active_Isochronous_Speed_State
HSG_Indicated_Isochronous_Speed_State

State	Alpha Value	Enumeration
HSG_Iso_State	ISOCHRONOUS	0
HSG_Iso_Switched_Max_Op_Speed	SWITCHED_ISO	1
HSG_Iso_Zero_VSS	ZERO_VSS	2
HSG_Iso_SM_State	SHIFT_MNGR	3

A/D SENSOR STATUS INFORMATION:

Air_Press_Status
Battery_Volt_Status
Charge_Press_Status
Charge_Tmptr_Status
Compressor_Inlet_Tmptr_Status
Coolant_Lvl_Status
Coolant_Tmptr_Status
ECM_Internal_Tmptr_Status
EGR_Delta_Press_Status
EGR_Orifice_Tmptr_Status
EGR_Position_Status
Exhaust_Press_Status
Fuel_Rail_Press_Status
Fuel_Tmptr_Status
OEM_Ambient_Air_Tmptr_Status
Oil_Press_Status
Oil_Tmptr_Status
Remote_Throt_Status
Sampled_Throt_Status
Supply_1_Volt_Status
Supply_2_Volt_Status
Turbo_Speed_Status
WIF_Status

State	Alpha Value	Decimal Value	Bit Mask
GOOD	GOOD	0	0
OOR_SUSPECT	OS	1	1
OOR_FAILED	OF	2	2
AP_SUSPECT	AS	4	3
AP_FAILED	AF	8	4
IR_SUSPECT	IS	16	5
IR_FAILED	IF	32	6
EST_SUSPECT	ES	64	7
EST_FAILED	EF	128	8

SENSOR ESTIMATION STATUS INFORMATION:

Charge_Press_EStat
Charge_Tmptr_EStat
Exhaust_Press_Estat
Turbo_Speed_EStat

State	Alpha Value	Decimal Value	Bit Mask
GOOD	GOOD	0	0
OOR_SUSPECT	OS	1	1
OOR_FAILED	OF	2	2
AP_SUSPECT	AS	4	3
AP_FAILED	AF	8	4
IR_SUSPECT	IS	16	5
IR_FAILED	IF	32	6
EST_SUSPECT	ES	64	7
EST_FAILED	EF	128	8

A/D SENSOR SOURCE INFORMATION:

Air_Press_Source
Battery_Volt_Source
Charge_Press_Source
Charge_Press_Gauge_Source
Charge_Tmptr_Source
Compressor_Inlet_Tmptr_Source
Coolant_Lvl_Source
Coolant_Tmptr_Source
ECM_Internal_Tmptr_Source
EGR_Delta_Press_Source
EGR_Orifice_Tmptr_Source
EGR_Position_Source
Exhaust_Press_Source
Fuel_Rail_Press_Source
Fuel_Tmptr_Source
OEM_Ambient_Air_Tmptr_Source
Oil_Press_Absolute_Source
Oil_Press_Source
Oil_Tmptr_Source
Remote_Throt_Source
Sampled_Throt_Source
Turbo_Speed_Source
WIF_Source

State	Alpha Value	Decimal Value	Bit Mask
SENSOR_PRIMARY	PRIMARY	0	0
SENSOR_BACKUP	BACKUP	1	1
SENSOR_DEFAULT	DEFAULT	2	2

VIRTUAL SENSOR SOURCE INFORMATION:

Altitude_Source
Ambient_Air_Press_Source
Ambient_Air_Tmptr_Source
Charge_Flow_Source
Charge_Saturation_Tmptr_Source
Compressor_Inlet_Density_Source
Compressor_Inlet_Press_Source
Compressor_Outlet_Tmptr_Source
EGR_Flow_Source
EGR_Valve_Delta_Press_Source
Engine_Delta_Press_Source
Exhaust_Saturation_Tmptr_Source
Fresh_Air_Flow_Source

State	Alpha Value	Decimal Value	Bit Mask
SENSOR_PRIMARY	PRIMARY	0	0
SENSOR_BACKUP	BACKUP	1	1
SENSOR_DEFAULT	DEFAULT	2	2

A/D SENSOR STATE INFORMATION:

Air_Press_State
Battery_Volt_State
Charge_Press_State
Charge_Tmptr_State
Compressor_Inlet_Tmptr_State
Coolant_Lvl_State
Coolant_Tmptr_State
ECM_Internal_Tmptr_State
EGR_Delta_Press_State
EGR_Orifice_Tmptr_State
EGR_Position_State
Exhaust_Press_State
Fuel_Rail_Press_State
Fuel_Tmptr_State
OEM_Ambient_Air_Tmptr_State
Oil_Press_State
Oil_Tmptr_State
Remote_Throt_State
Sampled_Throt_State
Supply_1_Volt_State
Supply_2_Volt_State
Turbo_Speed_State
WIF_State

State	Alpha Value	Decimal Value	Bit Mask
GOOD	GOOD	0	0
OOR_SUSPECT	OS	1	1
OOR_FAILED	OF	2	2
AP_SUSPECT	AS	4	3
AP_FAILED	AF	8	4
IR_SUSPECT	IS	16	5
IR_FAILED	IF	32	6
EST_SUSPECT	ES	64	7
EST_FAILED	EF	128	8

ENGINE SPEED PROCESSING (EPS) STATES:

EPS_Sensor_Select

State	Alpha Value	Enumeration
Main_EPS	MAIN	0
Backup_EPS	BACKUP	1

EPS_Main_Synch_State
EPS_Backup_Synch_State

State	Alpha Value	Enumeration
EPS_No_Pulse	NO_PULSE	0
EPS_Have_Sync	HAVE	1
EPS_No_Sync	NO_SYNC	2
EPS_Start_Sync	START	3

EPS_Status

State	Alpha Value	Enumeration
EPS_Stopped	STOPPED	0
EPS_Degraded	DEGRADED	1
EPS_Healthy	HEALTHY	2
EPS_Failed	FAILED	3

EPS_Cam_Cycle_State

State	Alpha Value	Enumeration
Unknown	UNKNOWN	0
No_Cam	NO_CAM	1
Known	KNOWN	2

VEHICLE SPEED SENSOR STATES:

RSC_Sensor_Type

State	Alpha Value	Enumeration
None	NONE	0
Inductive	INDUCTIVE	1
Mini_Gen	MINIGEN	2
Tachograph	TACH	3
Datalink_Tailshaft_Speed	DL_W_GR OOG	4
Unused	UNUSED	5
J1939 Tachometer	1939TACH	6

VSS_Transmission

State	Alpha Value	Enumeration
Manual_Transmission	MANUAL	0
Automatic_Transmission	AUTOMATIC	1
Fully_Automated_Manual_Transmission	FULL_AMT	2
Partially_Automated_Manual_Transmission	PARTIAL_AMT	3
Automated_Transmission_No_Clutch	AMT_NO_CLUTCH	4

VSS_Tamper_State

State	Alpha Value	Enumeration
VSS_No_Tampering	NO_TAMPR	0
VSS_Disconnected_Stop	DISCON_STP	1
VSS_Disconnected_Moving	DISCON_MOV	2
VSS_Const_Signal_State	CONSTANT	3
VSS_Noise_Signal_State	NOISE	4
VSS_Scaled_Signal_State	SCALED	5
VSS_Idle_Shutdown_State	IDLE_SD	6

GEAR DOWN / OUT OF GEAR PROTECTION STATES:

GD_State

State	Alpha Value	Enumeration
GD_Reset_State	RESET	1
GD_High_Load_State	HI_LOAD	2
GD_Wait_For_Filter_State	WAIT	3
GD_Preset_Ramp_State	PRESET	4
GD_Low_Load_State	LOW_LOAD	5
GD_Top_Gear_State	TOP_GEAR	6
GD_Decel_State	DECEL	7

Gear_Down_Active

State	Alpha Value	Enumeration
GDA_Top_Gear	TOP_GEAR	0
GDA_Gear_Down	GEAR_DWN	1
GDA_In_A_Low_Gear	LOW_GEAR	2

Out_Of_Gear_Protection

State	Alpha Value	Enumeration
OOG_Steady_State_Inactive	SS_INACTIVE	0
OOG_Steady_State_Active	SS_ACTIVE	1
OOG_Ramping_Up	RAMP_UP	2
OOG_Ramping_Down	RAMP_DOWN	3

CRUISE CONTROL STATES:

Cruise_Command_Mode

State	Alpha Value	Enumeration
CC_Off	OFF	0
Set	SET	1
Resume	RESUME	2
Coast	COAST	3
Accel	ACCEL	4
Bump_Down	BUMPDWN	5
Bump_Up	BUMPUP	6
CC_Hold	HOLD	7
Cancel	CANCEL	8
VORAD Headway	HEADWAY	9

J1939_Cruise_Command_Mode

State	Alpha Value	Enumeration
Cruise Off	OFF	0
Cruise Hold	HOLD	1
Cruise Accelerate	ACCEL	2
Cruise Decelerate	DECEL	3
Cruise Resume	RESUME	4
Cruise Set	SET	5
Cruise Accel Override	ACOVRRIDE	6
Cruise Not Available	NOT_AVAIL	7

Cruise_Control_AR_Flag

State	Alpha Value	Enumeration
AR_Inactive	INACTIVE	0
AR_Active	ACTIVE	1
AR_Pre_Active	PRE_ACTIVE	2
AR_Resume	RESUME	3
AR_After_Test	AFTER_TEST	4

Adaptive_Cruise_Control_Mode

State	Alpha Value	Enumeration
No Cruise Control	NO_CRUISE	0
Normal Cruise Control	NORMAL_CRUISE	1
VORAD Headway Cruise	HEADWAY_CRUISE	2

ENGINE BRAKES STATES:

E_Brake_Command_Source

State	Alpha Value	Enumeration
Not_Commanded	NONE	0
JCOMM_Over_Ride	JCOMMOVD	1
Cruise_Control	CRUISE	2
Switch_Input	SWITCH	3
JCOMM_Limit	JCOMMLMT	4
Source_Not_Set	NOT_SET	5
No_Override	NOOVERDE	6
Hydraulic_Retarder_Cmd	HYD_RTDR	7
Powertrain_Protection	PTP	8
EGR_Protection	EGR_PROT	9

EB_Allowed_State

State	Alpha Value	Enumeration
No_Ebrakes	NONE	0
Override_Only	OVERRIDE	1
Override_Or_Non_Override	OVER_OR_NON	2

Engine_Brake_Jcomm_Device_Indicator
Jcomm_Retarder_Control_Device_Indicator

State	Alpha Value	Enumeration
No_Device	NODEVICE	0
Transmission_Control	TRANSMIS	1
ABS_Control	ABS	2
ASR_Control	ASR	3
Unknown_Control	UNKNOWN	4
PTO_Control	PTO	5
VORAD Headway_Control	HEADWAY	6

ENGINE BRAKES STATES / JCOMM RETARDER:
Jcomm_Retarder_Control_Mode

State	Alpha Value	Enumeration
Retarder_Override_Disabled	DISABLE	0
Retarder_Torque_Control	TORQUE	2
Limit_Retarder	LIMIT	3

Jcomm_Retarder_Control_Mode_Test_Point

State	Alpha Value	Enumeration
Retarder_Override_Disable_Test	OVR_DSBL	0
No_Retarder_Test	NO_TEST	1
Retarder_Torque_Control_Test	TRQ_CNTL	2
Limit_Retarder_Test	LIM_RTRD	3

BRAKE SWITCH STATES:
Valid_Brake_Switch

State	Alpha Value	Enumeration
Brake_Inactive	OFF	0
Brake_Active	ON	1
Brake_Invalid_Inactive	STUCK_OFF	2
Brake_Invalid_Active	STUCK_ON	3

ACCELERATOR PEDAL STATES:
Accelerator_Pedal_State

State	Alpha Value	Enumeration
Fully_Released	RELEASE	0
Partially_Depressed	PART_DEP	1
Fully_Depressed	FULL_DEP	2

IDLE SHUTDOWN STATES:
Idle_Shutdown_State

State	Alpha Value	Enumeration
Reset	RESET	0
Count	COUNT	1
Warning	WARNING	2
Delay	DELAY	3
Overridden	OVERRIDE	4
Shutdown	SHUTDOWN	5

POWER TAKE-OFF (PTO) STATES:
PTO_State

State	Alpha Value	Enumeration
Remote_Count	REMOTE_COUNT	0
Remote_Run	REMOTE_RUN	1
Wait	WAIT	2
Normal_PTO	NORMAL	3

J1939_PTO_State

State	Alpha Value	Enumeration
Off	OFF	0
Hold	HOLD	1
Remote_Hold	REM_HOLD	2
Decelerate	DECEL	6
Accelerate	ACCEL	8
Accelerate_Override	ACCEL_OV	9
Preprogrammed_Set_Speed_1	PROGSPD1	10
Preprogrammed_Set_Speed_2	PROGSPD2	11
Preprogrammed_Set_Speed_3	PROGSPD3	12
Preprogrammed_Set_Speed_4	PROGSPD4	13
Preprogrammed_Set_Speed_5	PROGSPD5	14
Preprogrammed_Set_Speed_6	PROGSPD6	15
Preprogrammed_Set_Speed_7	PROGSPD7	16
Preprogrammed_Set_Speed_8	PROGSPD8	17

FAN CONTROL STATES:

Fan_Drive_State

State	Alpha Value	Enumeration
Fan_Drive_Off	OFF	0
Fan_Drive_General_Engine	ENGINE	1
Fan_Drive_IMT_Cooling	IMT_COOL	2
Fan_Drive_OT_Cooling	OT_COOL	3
Fan_Drive_CT_Cooling	CT_COOL	4
Undefined	UNUSE5	5
Undefined	UNUSE6	6
Undefined	UNUSE7	7
Undefined	UNUSE8	8
Fan_Drive_Manual_Switch	MANUAL	9
Undefined	NOCODE	10
Fan_Drive_AC_Switch	AC_SWITCH	11
Fan_Drive_IMT_Timer	IMT_TIME	12
Fan_Drive_Loading	LOADING	13
Fan_Drive_Other	OTHER	14
Fan_Drive_J1939_Not_Available	JNOT_AVL	15
Fan_Drive_Misc	MISC	16
Fan_Drive_Tool	TOOL	17
Fan_Drive_Datalink	DATALINK	18
Fan_Drive_OEM_Pressure	OEMPRES	19
Fan_Drive_OEM_Temperature	OEMTEMP	20
Fan_Drive_Fuel_Temperature	FUELTEMP	21

Fan_Clutch_1_Type

State	Alpha Value	Enumeration
On_Off	ON_OFF	0
Active High / Low	HIGH_LOW_OFF	1
Variable	VARIABLE	2

Fan_Clutch_Logic

State	Alpha Value	Enumeration
Active_High (12V FAN ON)	FALSE	0
Active_Low (12V FAN OFF)	TRUE	1

Fan_Clutch_Status

State	Alpha Value	Enumeration
Fan_Clutch_Off	FC_OFF	0
Fan_Clutch_On	FC_ON	1
Fan_Clutch_Active_Low	FC_LOW	2
Fan_Clutch_Active_High	FC_HIGH	3

POWERTRAIN STATES:

Powertrain_State

State	Alpha Value	Enumeration
Not_Set	NOT_SET	0
Fueling_Jcomm_Torque_State	JCOMTORQ	1
Fueling_Jcomm_Speed_State	JCOMSPED	2
Fueling_Jcomm_Torque_Derate_State	JCTRQDER	3

DRIVER REWARD STATES:

DR_CC_RSG_Both_Option

State	Alpha Value	Enumeration
DR_Type_RSG	RSG	0
DR_Type_CC	CRUISE	1
DR_Type_Both	BOTH	2

DR_Reward_State

State	Alpha Value	Enumeration
DR_State_None	NONE	0
DR_State_1	DR_STAT1	1
DR_State_2	DR_STAT2	2
DR_State_3	DR_STAT3	3
DR_State_4	DR_STAT4	4

ENGINE START STATES:

ES_State

State	Alpha Value	Enumeration
Aborted	ABORT	0
Begin	BEGIN	1
Proceed	PROCEED	2
OK_To_Autostart	AUTO_OK	3
Started	STARTED	4
ES_Wait	ES_WAIT	5
Key_Switch_Off	KEYSWOFF	6
OK_To_Manual_Start	MANUAL_OK	7
Alarm_Delay	ALARM	8

ENGINE DATA FILES:

EDF_Coolant_Temp_Abuse_Type
EDF_Oil_Temp_Abuse_Type
EDF_Engine_Ovrspd_Abuse_Type
EDF_Coolant_Pres_Abuse_Type
EDF_IMT_Abuse_Type
EDF_Coolant_Lvl_Abuse_Type
EDF_Oil_Pres_Abuse_Type
EDF_Blowby_Pres_Abuse_Type

State	Alpha Value	Enumeration
EDF_No_Source	NONE	0
EDF_Discrete_Source	DISCRETE	1
EDF_Analog_Source	ANALOG	2
EDF_Error_Source	ERROR	3

EDF_Coolant_Temp_Abuse_Min_Or_Max
EDF_Oil_Temp_Abuse_Min_Or_Max
EDF_Engine_Ovrspd_Abuse_Min_Or_Max
EDF_Coolant_Pres_Abuse_Min_Or_Max
EDF_IMT_Abuse_Min_Or_Max
EDF_Coolant_Lvl_Abuse_Min_Or_Max
EDF_Oil_Pres_Abuse_Min_Or_Max
EDF_Blowby_Pres_Abuse_Min_Or_Max

State	Alpha Value	Enumeration
EDF_Max	MAX	0
EDF_Min	MIN	1

ANTI-THEFT STATES:

Anti_Theft_State

State	Alpha Value	Enumeration
Unlocked_While_Stopped	STOP_UNLOCK	0
Locked_While_Running	RUN_LOCK	1
Unlocked_While_Running	RUN_UNLOCK	2
Tampered_With_Vehicle	TAMPER	3
Locked_While_Stoppped	STOP_LOCK	4

AT_Password_State

State	Alpha Value	Enumeration
No_Entry	NO_ENTRY	0
Good_Entry	GOOD_ENTRY	1
Bad_Entry	BAD_ENTRY	2

AT_Engine_Lock_State
AT_Engine_Lock_State_Request

State	Alpha Value	Enumeration
Unlocked	FALSE	0
Locked	TRUE	1

JCOMM ANTI-THEFT STATES:

Jcomm_AT_Command_State

State	Alpha Value	Enumeration
Add_Password	ADD_PASSWD	0
Delete_Password	DEL_PASSWD	1
Change_Password	CHG_PASSWD	2
Lock_Or_Unlock	LOCK_UNLOCK	3
Check_Status	CHECK	4
Login	LOGIN	5
Idle_State	IDLE	6
IBZ_Idle_State	IBZ_IDLE	7

Jcomm_AT_Component_Status

State	Alpha Value	Enumeration
Unlocked	UNLOCK	0
Locked	LOCK	1
Blocked	BLOCK	2

Jcomm_AT_Desired_Exit_Mode

State	Alpha Value	Enumeration
Lock_Upon_Operator_Request	LOCK_RQST	0
Lock_When_Key_Off	LOCK_KEYOFF	1
Not_Available	NOT_AVAIL	2

Jcomm_AT_Encryption_Indicator

State	Alpha Value	Enumeration
Encryption_Seed_Request	REQUEST	0
Encryption_Password_Present	PRESENT	1
Indicator_Not_Available	NOT_AVAIL	2

TRIP INFORMATION STATES:

Trip_Info_State

State	Alpha Value	Enumeration
TI_EPF_Derate	EPF_DER	0
TI_Air_Compressor	AIR_COMP	1
TI_Battery_Auto_Start	BATT_AS	2
TI_Block_Auto_Start	BLOCK_AS	3
TI_Bunk_Auto_Start	BUNK_AS	4
TI_Engine_ESP	ENG_ESP	5
TI_Driver_Reward_1	DR_1	6
TI_Driver_Reward_2	DR_2	7
TI_Driver_Reward_3	DR_3	8
TI_Vehicle_ESP	VEH_ESP	9
TI_Fan_Due_To_Ext	FAN_EXT	10
TI_Fan_Due_To_AC	FAN_AC	11
TI_Fan_Due_To_Engine	FAN_ENG	12
TI_Fan_1_With_MPH	FAN_1_MPH	13
TI_Fan_1_Without_MPH	FAN_1_NOMPH	14
TI_Vehicle_Out_Of_Gear	VEH_OOG	15
TI_Engine_Drive	ENG_DRIVE	16
TI_Engine_Idle	ENG_IDLE	17
TI_Fast_Engine_Idle	FAST_ENG_IDLE	18
TI_Engine_PTO	ENG_PTO	19
TI_Hot_Shutdown	HOT_SD	20
TI_Warmup_Violation	WARM_VIOL	21
TI_Idle_Shutdown	IDLE_SD	22
TI_Idle_Shutdown_Override	IDLE_SD_OVR	23
TI_Engine_Revving	ENG_REV	24
TI_Engine_Overrev	ENG_OVERREV	25
TI_Vehicle_Drive	VEH_DRIVE	26
TI_Vehicle_PTO	VEH_PTO	27
TI_Cruise	CRUISE	28
TI_RSG	RSG	29
TI_Vehicle_Coast	VEH_COAST	30
TI_Vehicle_Above_Sweet_Spot	ABV_SWSP	31
TI_Vehicle_Below_Sweet_Spot	BEL_SWSP	32
TI_Vehicle_Brake	VEH_BRAKE	33
TI_Top_Gear	TOP_GEAR	34
TI_Gear_Down	GEAR_DWN	35
TI_Engine_Brakes	E_BRAKE	36
TI_Vehicle_Overspeed_1	VEH_OS_1	37
TI_Vehicle_Overspeed_2	VEH_OS_2	38
TI_Vehicle_Deceleration	VEH_DEC	39
TI_ECM	ECM	40
TI_Fan_2_On	FAN_2_ON	41
TI_Engine_On	ENG_ON	42
TI_Vehicle_PTO_Loaded_And_Not_Moving	PTO_NO_VSS	43
TI_Vehicle_PTO_Loaded_And_Moving	PTO_VSS	44
TI_Auto_Start	AUTO_STRT	45
TI_Engine_Sleep_Idle	ENG_SLEP_IDLE	46
Unused	UNUSED	47

SYSTEM SWITCH STATUS:

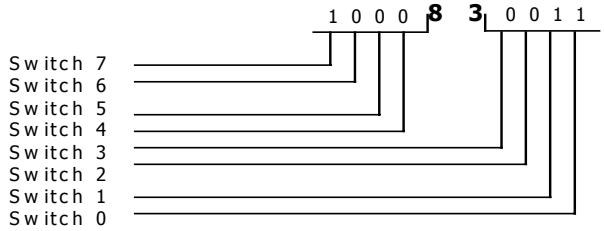
System_Switch_Status [SSSWSS01]

Switch	BIT #
Keyswitch	0
Test_Switch	1
Increment_Switch	2
Decrement_Switch	3
Cruise_Control_On_Switch	4
Cruise_Control_Set_Switch	5
Cruise_Control_Resume_Switch	6
PTO_On_Switch	7
PTO_Set_Switch	8
PTO_Resume_Switch	9
Brake_Switch	10
Clutch_Switch	11
Engine_Brake_Select_1	12
Engine_Brake_Select_2	13
Engine_Brake_Select_3	14
Manual_Fan_Input	15

System_Switch_Status_2 [SSSWSS02]

Switch	BIT #
Air_Conditioner_Pressure_Switch	0
Idle_Switch	1
Not_Idle_Switch	2
Remote_Throttle_Switch	3
Remote_PTO_Switch	4
PTP_Switched_Input	5
Accelerator_Interlock_Switch	6
EPF_Shutdown_Override_Switch	7
STCG_ASG_Droop_Switch	8
Remote_Oil_Switch	9
Sensor_Supply_Monitor_A	10
Rear_Axle_Ratio_Switch	11
HSG_Droop_Select_Switch	12
Unused	13
Unused	14
Unused	15

1 = SWITCH ACTIVE							
0 = SWITCH NOT ACTIVE							
0000 = 0	0001 = 1	0010 = 2	0011 = 3	0100 = 4	0101 = 5	0110 = 6	0111 = 7
1000 = 8	1001 = 9	1010 = A	1011 = B	1100 = C	1101 = D	1110 = E	1111 = F



CM870 FAULT CODE LIST

Diag_hdd02.doc REV 52

FAULT CODE	DESCRIPTION OF FAULT	SYSTEM ERROR PARAMETER NAME	CAUSED BY: LIMIT OR FAULT CONDITION
111	Engine Control Module - critical internal failure	Powerdown_EEPROM_Checksum_Error OR RAM_Image_Word_Error	Write Error to Flash / EEPROM Data Difference between RAM versus Flash/EEPROM
115	ISM'02: Engine Speed/Position Sensor Circuit – lost both of two signals from the magnetic pickup sensor	MS_EPS_Both_Coils_Shorted_Or_Open_Error	Both VR Sensor Circuits open or shorted
121	ISM'02: Engine Speed/Position Sensor Circuit – lost one of two signals from the magnetic pickup sensor	MS_EPS_Main_Or_Backup_Channel_Lost_Error OR MS_EPS_Coil_Shorted_Or_Open_Error	One of the VR Sensor Circuits open or shorted
122	Boost Pressure Sensor Circuit - shorted high.	Boost_Pressure_Absolute_High_Error	Boost_Pressure_Absolute_High_Limit
123	Boost Pressure Sensor Circuit - shorted low.	Boost_Pressure_Absolute_Low_Error	Boost_Pressure_Absolute_Low_Limit
131	Accelerator Pedal Position Sensor Circuit - shorted high.	Sampled_Throttle_High_Error	Sampled_Throttle_High_Limit
132	Accelerator Pedal Position Sensor Circuit - shorted low.	Sampled_Throttle_Low_Error	Sampled_Throttle_Low_Limit
133	Remote Throttle Pedal Position Sensor Circuit - shorted high.	RT_High_Error	Remote_Throttle_High_Error
134	Remote Throttle Pedal Position Sensor Circuit - shorted low.	RT_Low_Error	Remote_Throttle_Low_Error
135	Oil Pressure Sensor Circuit - shorted high.	Oil_Pressure_High_Postprocessed_Error	Oil_Pressure_Absolute_High_Limit
141	Oil Pressure Sensor Circuit - shorted low.	Oil_Pressure_Absoute_Low_Error	Oil_Pressure_Absolute_Low_Limit
143	Oil Pressure - data below normal range.	Oil_Pressure_Torque_Error	Oil Pressure Engine Protection
144	Coolant Temperature Sensor Circuit – shorted high.	Coolant_Temperature_High_Error	Coolant_Temperature_High_Limit
145	Coolant Temperature Sensor Circuit – shorted low.	Coolant_Temperature_Low_Error	Coolant_Temperature_Low_Limit
151	Coolant Temperature - data above normal range.	Coolant_Temperature_RPM_Error	Coolant Temperature Engine Protection
153	Intake Manifold Temperature Sensor Circuit - shorted high.	Intake_Manifold_Temperature_Sensor_High_Error	Intake_Manifold_Temperature_Sensor_High_Limit
154	Intake Manifold Temperature Sensor Circuit - shorted low.	Intake_Manifold_Temperature_Sensor_Low_Error	Intake_Manifold_Temperature_Sensor_Low_Limit
155	Intake Manifold Temperature - data above normal range. Critical.	IMT_RPM_Error	IMT Engine Protection
185	J1939 Master / Slave Communications Error – Loss of Communications	J1939_Master_Slave_Comm_Lost_Error	J1939 Master / Slave Communication Error
187	Sensor Supply 2 Voltage Circuit - shorted low.	Sensor_Supply_2_Voltage_Low_Error	Sensor_Supply_2_Voltage_Low_Limit
195	Coolant Level Sensor Circuit - shorted high.	T_Coolant_Level_High_Error	Coolant_Level_High_Limit
196	Coolant Level Sensor Circuit - shorted low.	T_Coolant_Level_Low_Error	Coolant_Level_Low_Limit
197	Coolant Level Low – warning.	CLS_Low_Coolant_Error	Coolant Level Engine Protection
212	Oil Temperature Sensor Circuit - shorted high.	Oil_Temperature_High_Error	Oil_Temperature_High_Limit
213	Oil Temperature Sensor Circuit - shorted low.	Oil_Temperature_Low_Error	Oil_Temperature_Low_Limit
214	Oil Temperature - data above normal range.	Oil_Temperature_Torque_Error OR Oil_Temperature_RPM_Error	Oil Temperature Engine Protection
219	CORS Oil Level Low - Warning	CORS_Remote_Oil_Level_Low_Error	CORS_Remote_Oil_Counter > C_CORS_Remote_Oil_Counter_Max
221	Ambient Air Pressure Sensor Circuit – shorted high.	Air_Pressure_Sensor_High_Error	Air_Pressure_Sensor_High_Limit
222	Ambient Air Pressure Sensor Circuit – shorted low.	Air_Pressure_Sensor_Low_Error	Air_Pressure_Sensor_Low_Limit
223	Oil Burn Valve Solenoid – shorted high	T_CORS_Burn_Valve_Driver_PWM_Low_Control_Error	CORS PWM Output Driver Shorted HIGH

FAULT CODE	DESCRIPTION OF FAULT	SYSTEM ERROR PARAMETER NAME	CAUSED BY: LIMIT OR FAULT CONDITION
224	Oil Burn Valve Solenoid – shorted low	T_CORS_Burn_Valve_Driver_PWM_High_Control_Error	CORS PWM Output Driver Shorted LOW
227	Sensor Supply 2 Voltage Circuit - shorted low.	Sensor_Supply_2_Voltage_High_Error	Sensor_Supply_2_Voltage_High_Limit
234	ENF'02: Engine Speed - data above normal range.	ES_Overspeed_Error	CM870 - Engine_Overspeed_Limit = 2650 RPM
234	ISM'02: Engine Speed - data above normal range.	MS_ES_Overspeed_Error	CM570 - FSOSLMES = 2650 RPM
241	Vehicle Speed Sensor Circuit - data incorrect.	VSS_Signal_Lost_Error	J1939 Tailshaft Speed Lost
242	Vehicle Speed Sensor Circuit - tampering detected.	VSS_Tampering_Error	VSS_IS_Tamper_Time
245	Fan Clutch Circuit - shorted low.	T_Fan_Clutch_1_PWM_High_Control_Error	Fan Clutch PWM Output Driver Shorted LOW
249	Ambient Air Temperature Sensor Circuit – shorted high.	T_OEM_Ambient_Air_Temperature_High_Error	Ambient_Air_Temperature_High_Limit
254	ENF'02: Fuel Shutoff Valve Circuit – shorted low.	FSO_PWM_High_Control_Error	Electrical Failure of FSO actuator / actuator driver
254	ISM'02: Fuel Shutoff Valve Circuit – shorted low.	MS_FSO_PWM_High_Control_Error	Electrical Failure of FSO actuator / actuator driver.
255	ENF'02: Fuel Shutoff Valve Circuit – shorted high.	FSO_PWM_Low_Control_Error	Electrical Failure of FSO actuator / actuator driver
255	ISM'02: Fuel Shutoff Valve Circuit – shorted high.	MS_FSO_PWM_Low_Control_Error	Electrical Failure of FSO actuator / actuator driver
256	Ambient Air Temperature Sensor Circuit – shorted low.	T_OEM_Ambient_Air_Temperature_Low_Error	Ambient_Air_Temperature_Low_Limit
259	ENF'02: Fuel Shutoff Valve – stuck open.	FSO_Stuck_Open_Error	FSOV - Fuel Pressure does not drop in gallery
259	ISM'02: Fuel Shutoff Valve – stuck open.	MS_FSO_Stuck_Open_Error	FSOV stuck mechanically open
263	Fuel Temperature Sensor Circuit – shorted high	Fuel_Temperature_High_Error	Fuel_Temperature_High_Limit
265	Fuel Temperature Sensor Circuit – shorted low	Fuel_Temperature_Low_Error	Fuel_Temperature_Low_Limit
284	Engine Speed Sensor Supply Voltage – data below normal range.	Engine_Speed_Sensor_SV_Low_Error	Sensor_Supply_Monitor_A = OFF
285	SAE J1939 Multiplexing – PGN timeout error.	J1939_Mux_PGN_Timeout_Error	J1939 MUX Time-Out / Loss Of Communications
286	SAE J1939 Multiplexing – configuration error.	J1939_Mux_Configuration_Error	J1939 MUX Configuration
287	SAE J1939 Multiplexing – accelerator pedal sensor system (APS) system error	J1939_Mux_APS_System_Error	J1939 MUX Accel Throttle Pedal Sensor Error
288	SAE J1939 Multiplexing – remote throttle data error.	J1939_Mux_Remote_Throttle_Data_Error	J1939 MUX Remote Throttle Error
295	Ambient Air Pressure – data incorrect.	Air_Pressure_Keyon_Error	Key-On Pressure In-Range Check
311	ISM'02: Injector Solenoid Valve Cyl #1 Circuit – Grounded Circuit	MS_Act1_FF_Shorted_HS_To_LS_Error	Injector Solenoid Valve Cyl #1 Shorted High Side to Low Side
312	ISM'02: Injector Solenoid Valve Cyl #5 Circuit – Grounded Circuit	MS_Act5_Shorted_HS_To_LS_Error	Injector Solenoid Valve Cyl #5 Shorted High Side to Low Side
313	ISM'02: Injector Solenoid Valve Cyl #3 Circuit – Grounded Circuit	MS_Act3_RF_Shorted_HS_To_LS_Error	Injector Solenoid Valve Cyl #1 Shorted High Side to Low Side
314	ISM'02: Injector Solenoid Valve Cyl #6 Circuit – Grounded Circuit	MS_Act6_Shorted_HS_To_LS_Error	Injector Solenoid Valve Cyl #1 Shorted High Side to Low Side
315	ISM'02: Injector Solenoid Valve Cyl #2 Circuit – Grounded Circuit	MS_Act2_FT_Shorted_HS_To_LS_Error	Injector Solenoid Valve Cyl #1 Shorted High Side to Low Side
319	Real Time Clock - power interrupt.	RTC_Power_Interrupt_Error	RTC_Power_Interrupt_Error_Inhibit = FALSE
321	ISM'02: Injector Solenoid Valve Cyl #4 Circuit – Grounded Circuit	MS_Act4_FT_Shorted_HS_To_LS_Error	Injector Solenoid Valve Cyl #1 Shorted High Side to Low Side

FAULT CODE	DESCRIPTION OF FAULT	SYSTEM ERROR PARAMETER NAME	CAUSED BY: LIMIT OR FAULT CONDITION
322	ISM'02: Injector Solenoid Valve Cyl #1 Circuit – Open Circuit	MS_Act1_Misc_Error	Injector Solenoid Valve Cyl#1 Open Circuit
323	ISM'02: Injector Solenoid Valve Cyl #5 Circuit – Open Circuit	MS_Act5_Misc_Error	Injector Solenoid Valve Cyl#5 Open Circuit
324	ISM'02: Injector Solenoid Valve Cyl #3 Circuit – Open Circuit	MS_Act3_Misc_Error	Injector Solenoid Valve Cyl#3 Open Circuit
325	ISM'02: Injector Solenoid Valve Cyl #6 Circuit – Open Circuit	MS_Act6_Misc_Error	Injector Solenoid Valve Cyl#6 Open Circuit
331	ISM'02: Injector Solenoid Valve Cyl #2 Circuit – Open Circuit	MS_Act2_Misc_Error	Injector Solenoid Valve Cyl#2 Open Circuit
332	ISM'02: Injector Solenoid Valve Cyl #4 Circuit – Open Circuit	MS_Act4_Misc_Error	Injector Solenoid Valve Cyl#4 Open Circuit
338	Idle Shutdown Vehicle Accessories Relay Driver – shorted high.	T_Idle_Shutdown_Driver_PWM_Low_Control_Error	Idle Shutdown PWM Output Driver Shorted HIGH
339	Idle Shutdown Vehicle Accessories Relay Driver – shorted low.	T_Idle_Shutdown_Driver_PWM_High_Control_Error	Idle Shutdown PWM Output Driver Shorted LOW
341	Engine Control Module – data lost.	All_Powerdown_Data_Lost_Error	Invalid Data within Parameter Blocks
343	Engine Control Module – warning internal hardware failure.	Poweroff_Command_Ignored_Error	Poweroff_Command_Ignored = TRUE
352	Sensor Supply 1 Voltage Circuit - shorted low.	Sensor_Supply_1_Voltage_Low_Error	Sensor_Supply_1_Voltage_Low_Limit
359	Engine Failed to Start.	ES_Auto_Start_Error	ICON Auto Start Error
386	Sensor Supply 1 Voltage Circuit - shorted high.	Sensor_Supply_1_Voltage_High_Error	Sensor_Supply_1_Voltage_High_Limit
387	Accelerator Pedal Sensor Supply Voltage Circuit – shorted high.	Throttle_Sensor_Supply_Voltage_High_Error	Throttle_Sensor_Supply_Voltage_High_Limit
415	Oil Pressure - data indicates very low oil pressure.	Oil_Pressure_RPM_Error	Oil Pressure Engine Protection
418	Water Detected In Fuel.	Water_In_Fuel_Error	Water_In_Fuel = WATER_IN_FUEL (2)
428	Water In Fuel Sensor Circuit – shorted high.	Water_In_Fuel_Postprocessed_High_Error	Water_In_Fuel_High_Limit
429	Water In Fuel Sensor Circuit – shorted low.	Water_In_Fuel_Postprocessed_Low_Error	Water_In_Fuel_Low_Limit
431	Accelerator Pedal Idle Validation Circuit - data incorrect.	Throttle_Validation_Switch_Low_Error	Idle_Switch and Not_Idle_Switch are ACTIVE
432	Accelerator Pedal Idle Validation Circuit - out of calibration.	Throttle_Validation_Process_Error	Idle_Switch and Not_Idle_Switch Invalid Input
433	Boost Pressure – data incorrect. (In-Range High Error)	Charge_Pressure_Keyon_Error	Key-On Pressure In-Range Check
434	Power Lost Without Ignition Off.	Powerdown_Data_Lost_Error	Power Loss Before Powerdown Data Saved
435	Oil Pressure - data incorrect.	Oil_Pressure_Keyon_Error	Key-On Pressure In-Range Check
443	Accelerator Pedal Sensor Supply Voltage Circuit 0 – shorted low.	Throttle_Sensor_Supply_Voltage_Low_Error	Throttle_Sensor_Supply_Voltage_Low_Limit
449	Fuel Pressure High - warning.	Fuel_Supply_Pressure_High_Error	FPM_lp_HighThreshold_c
482	Fuel Pressure Low - warning.	Fuel_Supply_Pressure_Low_Error	FPM_lp_LowThreshold_c
486	Injector Metering Rail #2 Pressure Low – warning.	Fuel_Error_Rear_Underfuel_Error	Uncontrolled Underfueling in Rear Bank
546	Fuel Delivery Pressure Sensor Circuit – shorted high.	Fuel_Rail_Pressure_High_Error	Fuel_Rail_Pressure_High_Limit
547	Fuel Delivery Pressure Sensor Circuit – shorted low.	Fuel_Rail_Pressure_Low_Error	Fuel_Rail_Pressure_Low_Limit
551	Accelerator Pedal Idle Validation Circuit – shorted low.	Throttle_Validation_Switch_High_Error	Idle_Switch and Not_Idle_Switch are INACTIVE
559	Injector Metering Rail #1 Pressure Low - warning.	Fuel_Error_Front_Underfuel_Error	Uncontrolled Underfueling in Front Bank
584	Starter Relay Circuit – shorted high	T_Starter_Lockout_Driver_PWM_Low_Control_Error	Starter Relay PWM Driver circuit – shorted HIGH
585	Starter Relay Circuit – shorted low	T_Starter_Lockout_Driver_PWM_High_Control_Error	Starter Relay PWM Driver circuit – shorted LOW

FAULT CODE	DESCRIPTION OF FAULT	SYSTEM ERROR PARAMETER NAME	CAUSED BY: LIMIT OR FAULT CONDITION
595	Turbocharger #1 Speed High - warning.	AH_Fuel_Derate_Latch_Error OR Turbo_Speed_High_Error	Turbo Speed above set limit: Turbo_Speed_High_Limit
596	Electrical Charging System Voltage High - warning.	AFW_High_Voltage_Error	AFW_12V[24V]_High_Voltage
597	Electrical Charging System Voltage Low - warning.	AFW_Low_Voltage_Error	AFW_12V[24V]_Low_Voltage
598	Electrical Charging System Voltage Low – critical.	AFW_Very_Low_Volts_Error	AFW_12V[24V]_Very_Low_Voltage
649	Change Lubricating Oil and Filter – maintenance	OCM_Interval_Warning_Error	OCM_Warning_Percent
687	Turbocharger #1 Speed Low - warning.	Turbo_Speed_Low_Error	Turbo_Speed_Low_Limit
689	Crankshaft Engine Speed Sensor Error	EPS_Main_No_Pulse_Error OR EPS_Main_No_Sync_Error	Crank EPS – Unstable or no signal detected
691	Compressor Inlet Temperature Sensor Circuit – shorted high	Compressor_Inlet_Temperature_High_Error	Compressor_Inlet_Temperature_High_Limit
692	Compressor Inlet Temperature Sensor Circuit – shorted low	Compressor_Inlet_Temperature_Low_Error	Compressor_Inlet_Temperature_Low_Limit
731	Engine Speed/Position #2 - mechanical misalignment between CAM and CRANK sensors.	EPS_Phase_Shift_Error	Phase between Cam and Crank EPS has deviated beyond calibration limits
778	Camshaft Engine Position Sensor Error	EPS_Backup_No_Pulse_Error OR EPS_Backup_No_Sync_Error	Cam EPS – Unstable or non signal detected
784	Adaptive Cruise Control – loss of communication.	Adaptive_Cruise_Control_Error	Adaptive Cruise Control (EATON VORAD) Error
951	ENF'02: Power Imbalance Between Cylinders Detected.	CBD_Trim_Limit_Error	CBD can no longer adjust balance to cylinders
951	ISM'02: Power Imbalance Between Cylinders Detected.	MS_CBD_Trim_Limit_Error	CBD can no longer adjust balance to cylinders
957	EGR Valve Position – Position Rate exceeds limit	EGR_Position_Rate_Error	C_EGR_Position_Rate_Thd (7.00%)
2271	Exhaust Gas Recirculation Valve Position Circuit - shorted high.	EGR_Position_Before_Autozero_High_Error	EGR_Position_Before_Autozero_High_Limit
2272	Exhaust Gas Recirculation Valve Position Circuit - shorted low.	EGR_Position_Before_Autozero_Low_Error	EGR_Position_Before_Autozero_Low_Limit
2273	Exhaust Gas Recirculation Valve Delta Pressure - shorted high.	EGR_Delta_P_Sensor_High_Error OR EGR_Orifice_Delta_Pressure_High_Error	EGR_Delta_P_Sensor_High_Limit EGR_Orifice_Delta_Pressure_High_Limit
2274	Exhaust Gas Recirculation Valve Delta Pressure - shorted low.	EGR_Delta_P_Sensor_Low_Error OR EGR_Orifice_Delta_Pressure_Low_Error	EGR_Delta_P_Sensor_Low_Limit EGR_Orifice_Delta_Pressure_Low_Limit
2277	Variable Geometry Turbo Output Device Driver – shorted high	T_VGT_Actuator_Pneumatic_Low_Control_Error	VG Pneumatic Actuator PWM Output Driver HIGH
2278	Variable Geometry Turbo Output Device Driver – shorted low	T_VGT_Actuator_Pneumatic_High_Control_Error	VG Pneumatic Actuator PWM Output Driver LOW
2311	Fueling Actuator #1 Circuit – open/grounded	Front_Fueling_Actuator_Impaired_Error OR Front_Fueling_Actuator_Severe_Error	Electrical Failure of Front Fueling Actuator / Actuator Driver
2312	Timing Actuator #1 Circuit – open/grounded	Front_Timing_Actuator_Impaired_Error OR Front_Timing_Actuator_Severe_Error	Electrical Failure of Front Timing Actuator / Actuator Driver
2313	Fueling Actuator #2 Circuit – open/grounded	Rear_Fueling_Actuator_Impaired_Error OR Rear_Fueling_Actuator_Severe_Error	Electrical Failure of Rear Fueling Actuator / Actuator Driver
2314	Timing Actuator #2 Circuit – open/grounded	Rear_Timing_Actuator_Impaired_Error OR Rear_Timing_Actuator_Severe_Error	Electrical Failure of Rear Timing Actuator / Actuator Driver
2321	Primary Engine Speed Sensor Intermittent Error	EPS_Main_Intermittent_Sync	Main EPS Sensor Intermittent Sync Error
2346	Turbine Inlet Temperature (calc.) – data above normal range.	Exhaust_Metal_Tmptr_Torque_Error OR Exhaust_Metal_Tmptr_RPM_Error	Exhaust Temperature Engine Protection; least severe
2347	Compressor Outlet Temperature (calc.) - data above normal range.	COT_Torque_Error OR COT_RMP_Error	Compressor Outlet Temperature Engine Protection; Least severe

FAULT CODE	DESCRIPTION OF FAULT	SYSTEM ERROR PARAMETER NAME	CAUSED BY: LIMIT OR FAULT CONDITION
2348	EGR Valve Position – failed automatic calibration procedure (autozero)	EGR_Valve_Autozero_Error	C_EGR_Position_AZ_Tolerence
2349	EGR Output Circuit – shorted high or open	EGA_Fault_HB1A OR EGA_Fault_HB1B	EGR Valve H-Bridge Circuit Fault
2351	EGR Output Circuit – shorted low	EGA_Fault_HB1_OC_HI	EGR Valve H-Bridge Circuit Fault – Overcurrent
2352	EGR Output Circuit – shorted high	EGA_Fault_HB1_OC_LO	EGR Valve H-Bridge Circuit Fault – Overcurrent
2353	EGR Output Circuit – excessive current detected	EGA_Fault_HB1_Inrush	EGR Valve H-Bridge Circuit Fault – High Current
2355	TB Air Shutoff Valve – shorted high	TB_Air_Shutoff_Valve_PWM_Low_Control_Error	VG Air Shutoff Valve PWM Output Driver HIGH
2356	TB Air Shutoff Valve – shorted low	TB_Air_Shutoff_Valve_PWM_High_Control_Error	VG Air Shutoff Valve PWM Output Driver LOW
2357	EGR Valve Control – EGR Motor Overcurrent detected; Mechanical System not responding properly or out of adjustment	EGA_Driver_OC_Fault	C_EGA_Driver_OC_Threshold
2359	EGR Valve Delta Pressure – data valid but above normal operating range EGR Valve Delta Pressure – Key-on Pressure check In-Range diagnostics	EGR_Delta_P_Autozero_Error OR EGR_DP_IR_Open_Error OR EGR_DP_IR_Closed_Error	C_EGR_Delta_P_AZ_Tolerence C_EGR_DP_IR_Startup_Pos_Thd C_EGR_DP_IR_Startup_Press_Thd
2362	Engine Brake Actuator Circuit #1 – shorted low	EB_Drv_1_PWM_High_Control_Post_Processing_Error	Engine Brake PWM Output Driver #1 short LOW
2363	Engine Brake Actuator Circuit #2 – shorted low	EB_Drv_2_PWM_High_Control_Post_Processing_Error	Engine Brake PWM Output Driver #2 short LOW
2365	Engine Brake Actuator Circuit #3 – shorted low	EB_Drv_3_PWM_High_Control_Post_Processing_Error	Engine Brake PWM Output Driver #3 short LOW
2366	Engine Brake Actuator Circuit #1 – shorted high	EB_Drv_1_PWM_Low_Control_Post_Processing_Error	Engine Brake PWM Output Driver #1 short HIGH
2367	Engine Brake Actuator Circuit #2 – shorted high	EB_Drv_2_PWM_Low_Control_Post_Processing_Error	Engine Brake PWM Output Driver #2 short HIGH
2368	Engine Brake Actuator Circuit #3 – shorted high	EB_Drv_3_PWM_Low_Control_Post_Processing_Error	Engine Brake PWM Output Driver #3 short HIGH
2372	Fuel Filter Restriction Sensor Circuit – Warning Level	Prs_Fuel_Filter_Clogged_Error	Triggered at High Engine Speed Low Pressure Fault (482) Triggered at Low Engine Speeds
2373	Exhaust Pressure Sensor – Shorted High	Exhaust_Pressure_Sensor_High_Error	Exhaust_Pressure_Sensor_High_Limit
2374	Exhaust Pressure Sensor Circuit – Shorted Low	Exhaust_Pressure_Sensor_Low_Error	Exhaust_Pressure_Sensor_Low_Limit
2375	EGR Orifice Temperature (ERT) Sensor Circuit – Shorted High	EGR_Orifice_Temperature_High_Error	EGR_Orifice_Temperature_High_Limit
2376	EGR Orifice Temperature (ERT) Sensor Circuit – Shorted Low	EGR_Orifice_Temperature_Low_Error	EGR_Orifice_Temperature_Low_Limit
2377	Fan Clutch Circuit – shorted high	T_Fan_Clutch_1_PWM_Low_Control_Error	Fan Clutch PWM Output Driver Shorted HIGH
2551	Injector Metering Rail #2 Pressure High – data valid but above normal operating range; moderately severe	Fuel_Error_Rear_Overfuel_Error	Uncontrolled Overfueling in Rear Bank
2552	Injector Metering Rail #1 Pressure High – data valid but above normal operating range; moderately severe	Fuel_Error_Front_Overfuel_Error	Uncontrolled Overfueling in Front Bank
2554	Exhaust Pressure Sensor Circuit – Data Invalid	Exhaust_Pressure_Keyon_Error	Key-On Pressure In-Range Check
2961	EGR Orifice Temperature – Data above normal range	EGR_Orifice_Tmptr_Torque_Error OR CHH_EGRT_Over_Temperature	EGR Orifice Temperature (ERT) Engine Protection C_CHH_EGRT_Disable_Thd
2962	EGR Orifice Temperature – Data above normal range - Critical	EGR_Orifice_Tmptr_RPM_Error	EGR Orifice Temperature (ERT) Engine Protection
2963	Coolant Temperature – Data Above Normal Range	Coolant_Temperature_Torque_Error	Coolant Temperature Engine Protection
2964	Intake Manifold Temperature – Data Above Normal Range	IMT_Torque_Error	IMT Engine Protection
2973	Intake Manifold Pressure Sensor Circuit – Data Incorrect	Charge_Press_IR_Error	Charge Pressure In-Range Error Detection

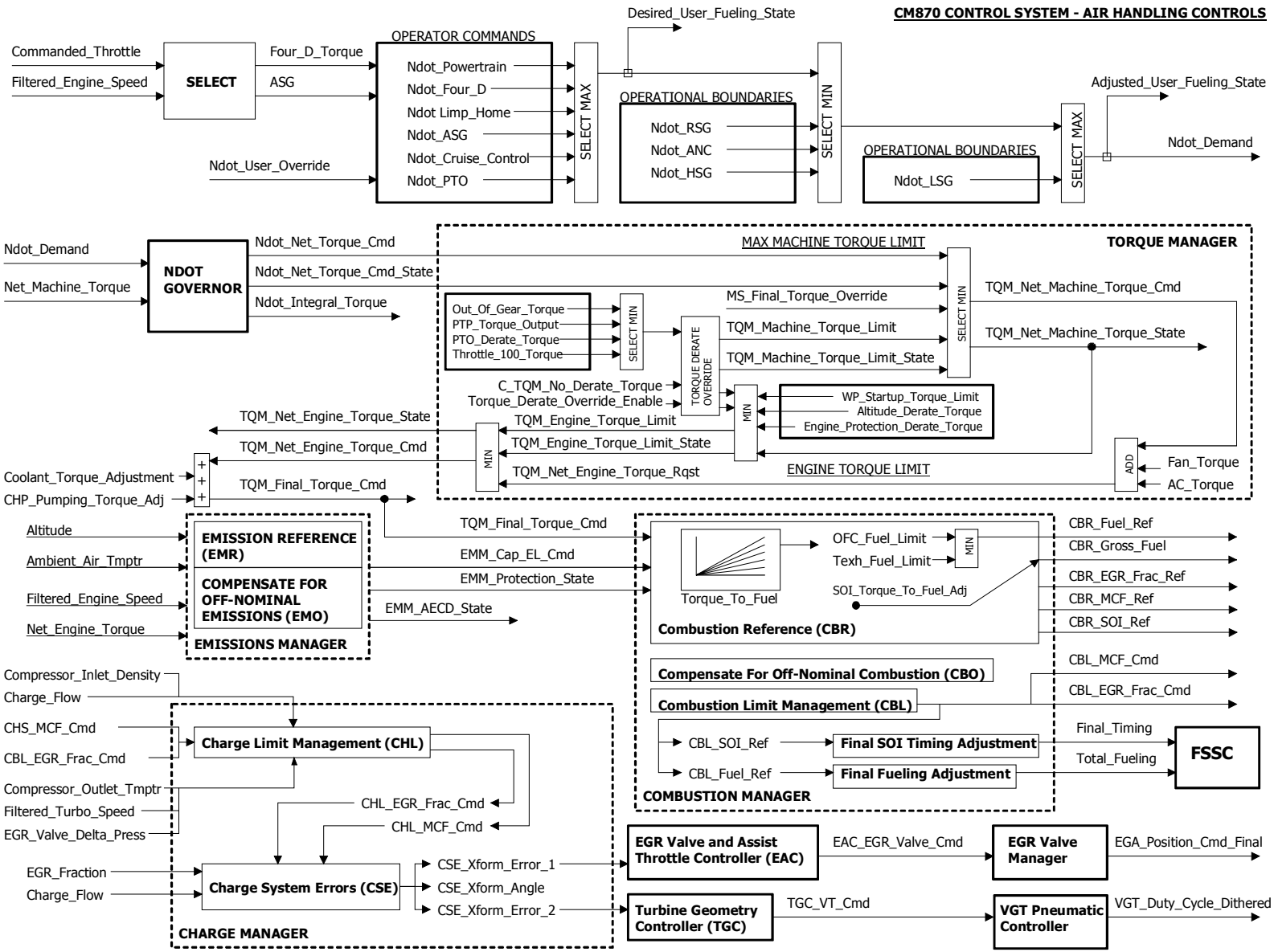
FAULT CODE	DESCRIPTION OF FAULT	SYSTEM ERROR PARAMETER NAME	CAUSED BY: LIMIT OR FAULT CONDITION
9114	Second Engine Control Module – data lost critical failure	MS_All_Powerdown_Data_Lost_Error	CM570 Power Loss Before Powerdown Data Saved
9115	CAN/J1939 Network #2 Communications Error	J1939_MS_Communication_Error	Error In Communication between CM870 and CM570 over CAN2 Datalink
9116	Second Engine Control Module – out of calibration	Master_Slave_Cal_Mismatch_Error	Mismatch between CM570 FS calibration and CM870 engine controls calibration
9117	Second Engine Control Module – critical internal failure	MS_RAM_Image_Word_Error OR MS_EEPROM_Write_Error OR MS_Boost_Voltage_Supply_Error OR MS_Poweroff_Command_Ignored_Error	CM570 Write Error to Flash / EEPROM Data Difference between RAM versus Flash/EEPROM
9118	Second Engine Control Module – non-critical failure	MS_Powerdown_Data_Lost_Error	CM570 Poweroff_Command_Ignored = TRUE
9119	Battery #1 Voltage Low – warning	MS_Battery_Voltage_Low_Error	CM570 Battery Voltage Low Error
9121	EGR Valve Actuator Over Temperature (Calculated) – Data Above Normal Range Least Severe Level	EGA_Over_Temperature	C_EGA_Tmptr_High_Threshold

CM870 CONTROL SYSTEM DIAGRAMS

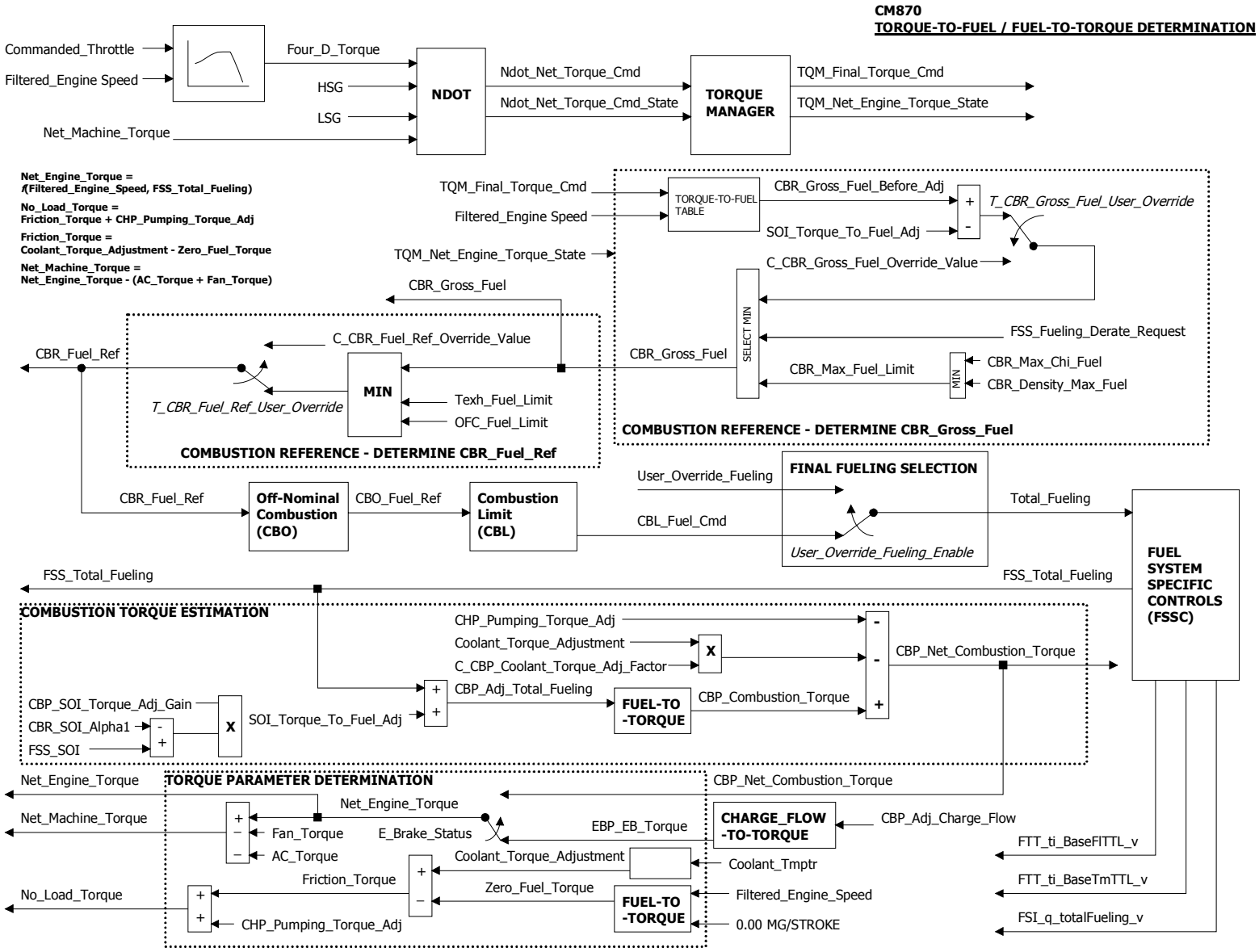
SYSTEM DIAGRAM CONTENTS:

- **CM870 CONTROL SYSTEM**
- **CM870 CONTROL SYSTEM – TORQUE TO FUEL DETERMINATION**
- **CM870 CONTROL SYSTEM – SOI DETERMINATION**
- **CM870 CONTROL SYSTEM – AIR HANDLING EGR VALVE / VG TURBOCHARGER CONTROLS**
- **CM870 CONTROL SYSTEM – NDOT GOVERNOR CONTROLS**
- **CM870 SENSOR INTERFACES (ENFORCER '02 ENGINE)**
- **CM870 SENSOR INTERFACES (ISM '02 ENGINE)**
- **CM870 AIR HANDLING CONTROL SYSTEM**
- **A/D SENSOR INPUT SYSTEM NAME CONFIGURATION**
- **INLET DENSITY CHI – CHI VALUE DETERMINATION (ENFORCER '02 FULL PRODUCTION ENGINES)**
- **INLET DENSITY CHI – CHI VALUE DETERMINATION (ISM '02 BETA ENGINES)**
- **AMBIENT OPERATING CONDITIONS – CHI VALUE DETERMINATION (ENFORCER '02 FULL PRODUCTION ENGINES)**
- **AMBIENT OPERATING CONDITIONS – CHI VALUE DETERMINATION (ISM '02 BETA ENGINES)**
- **CONDENSATION OVERVIEW (ENFORCER '02 / ISM '02)**

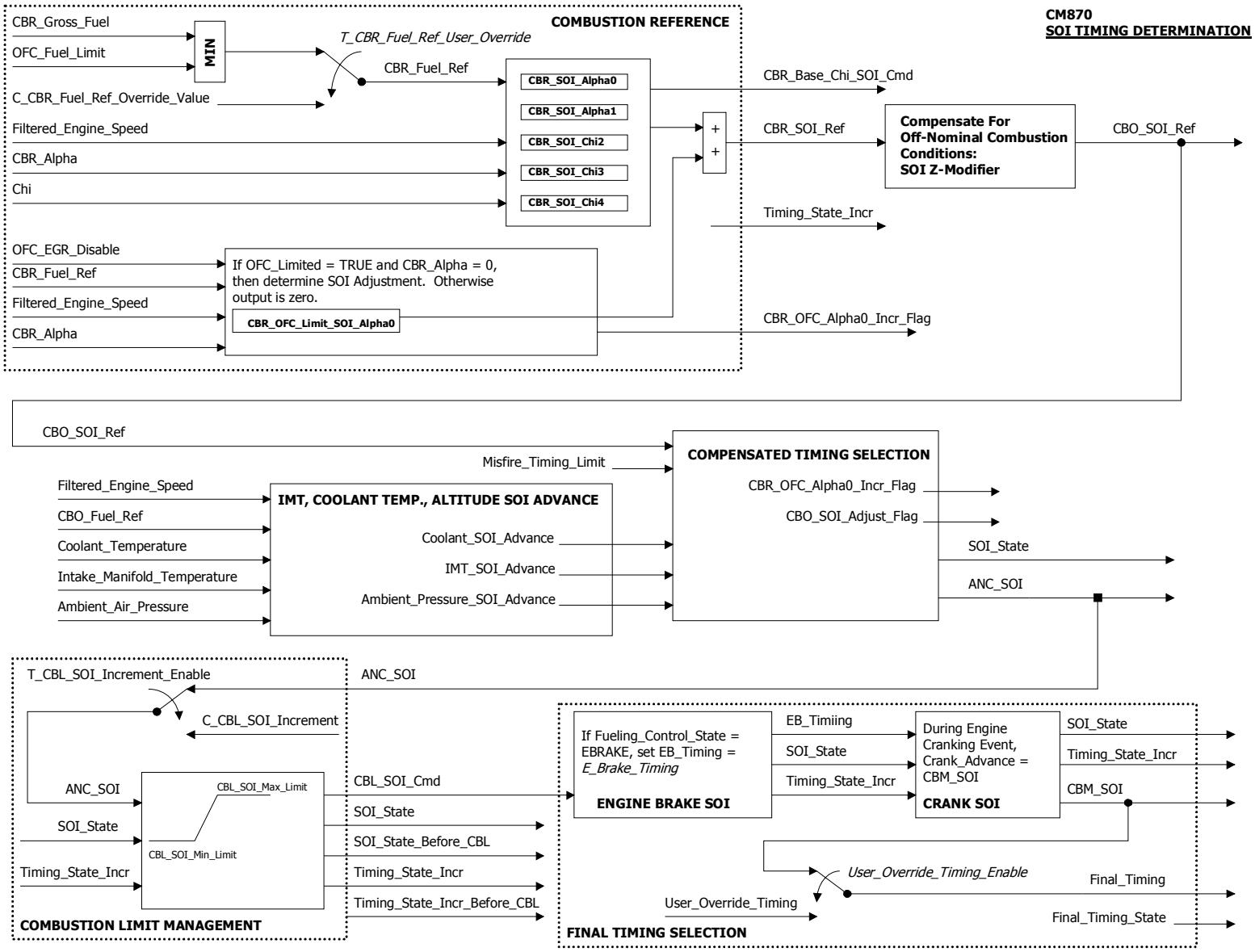
CM870 Control System:



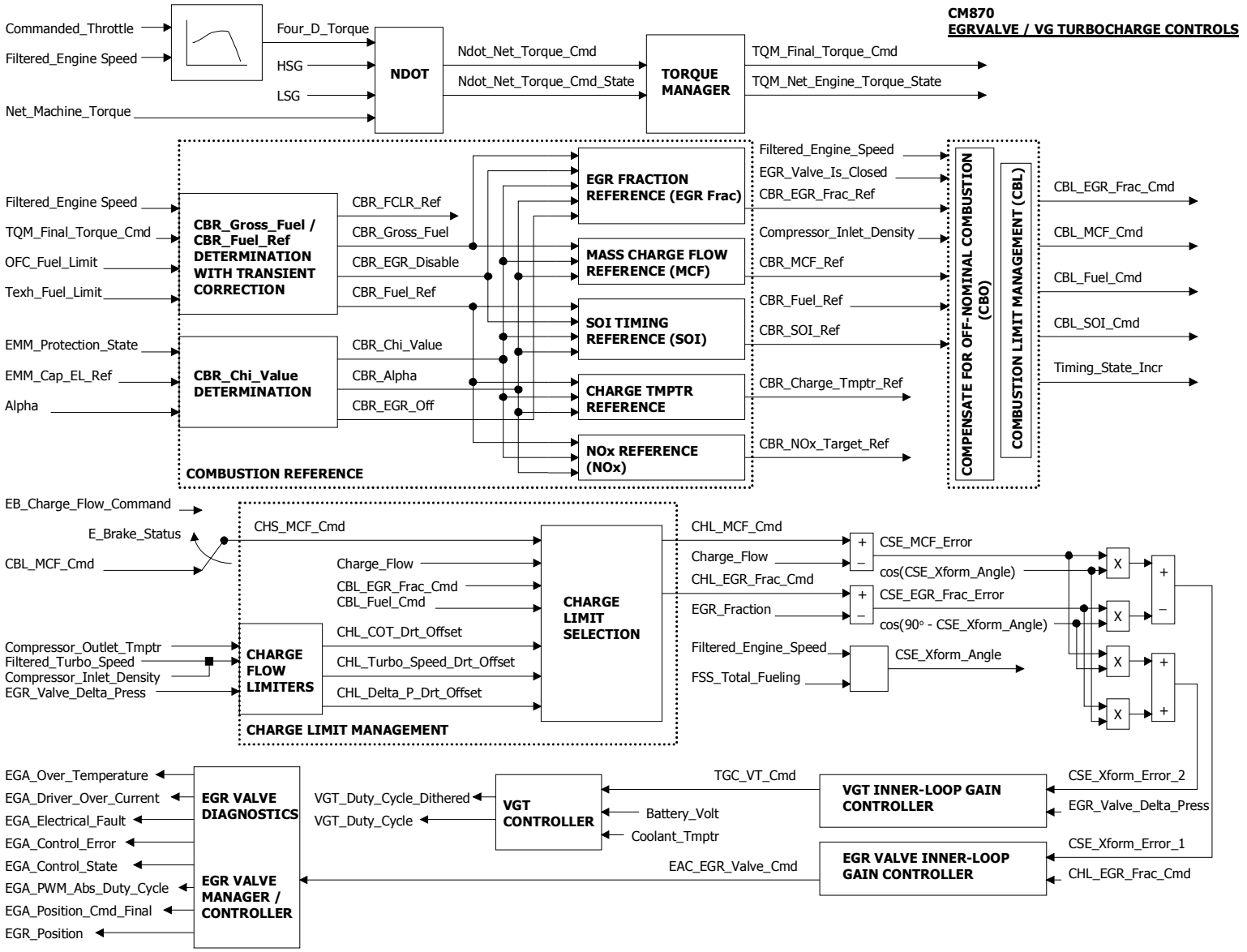
CM870 Control System – Torque To Fuel Determination:



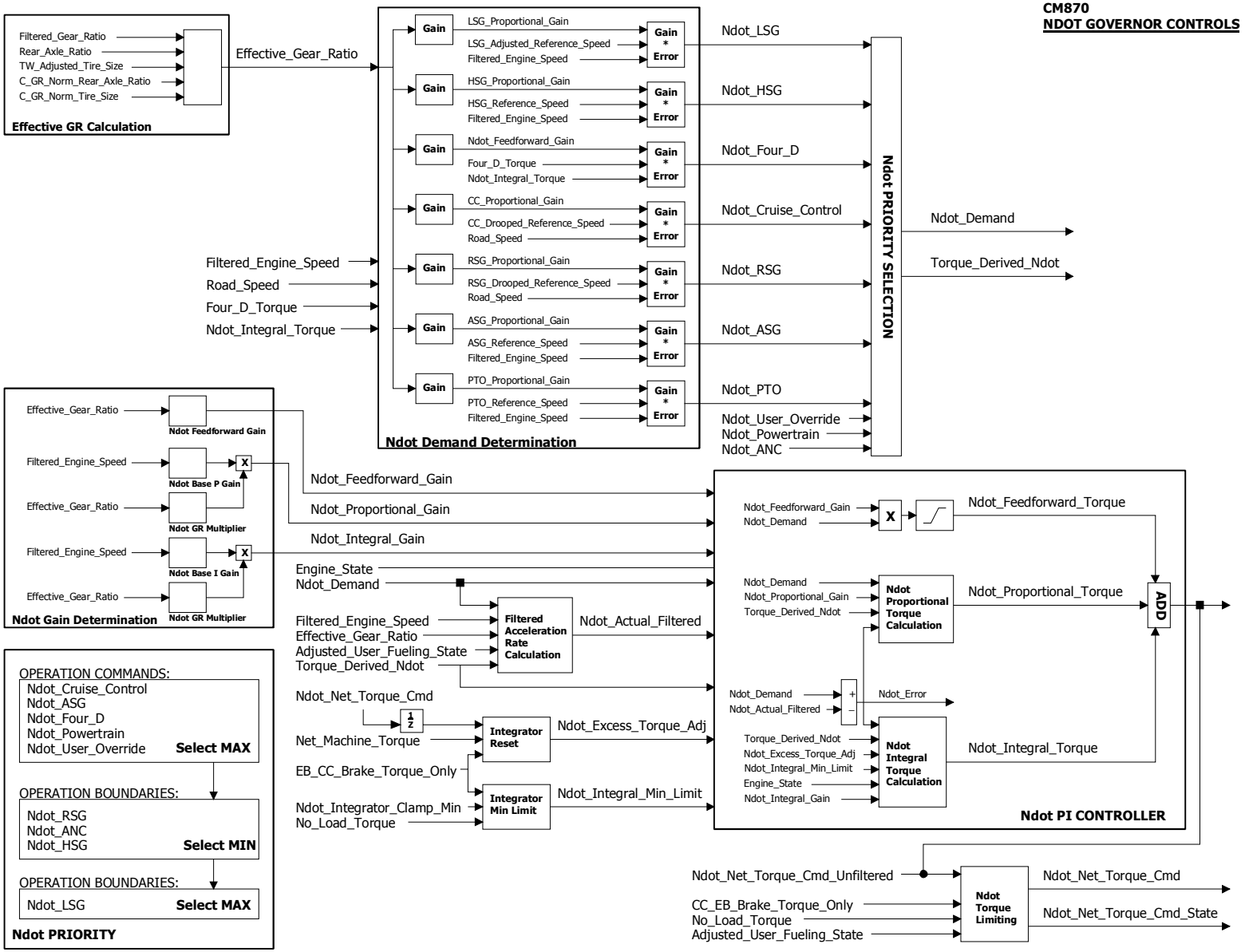
CM870 Control System – SOI Determination:



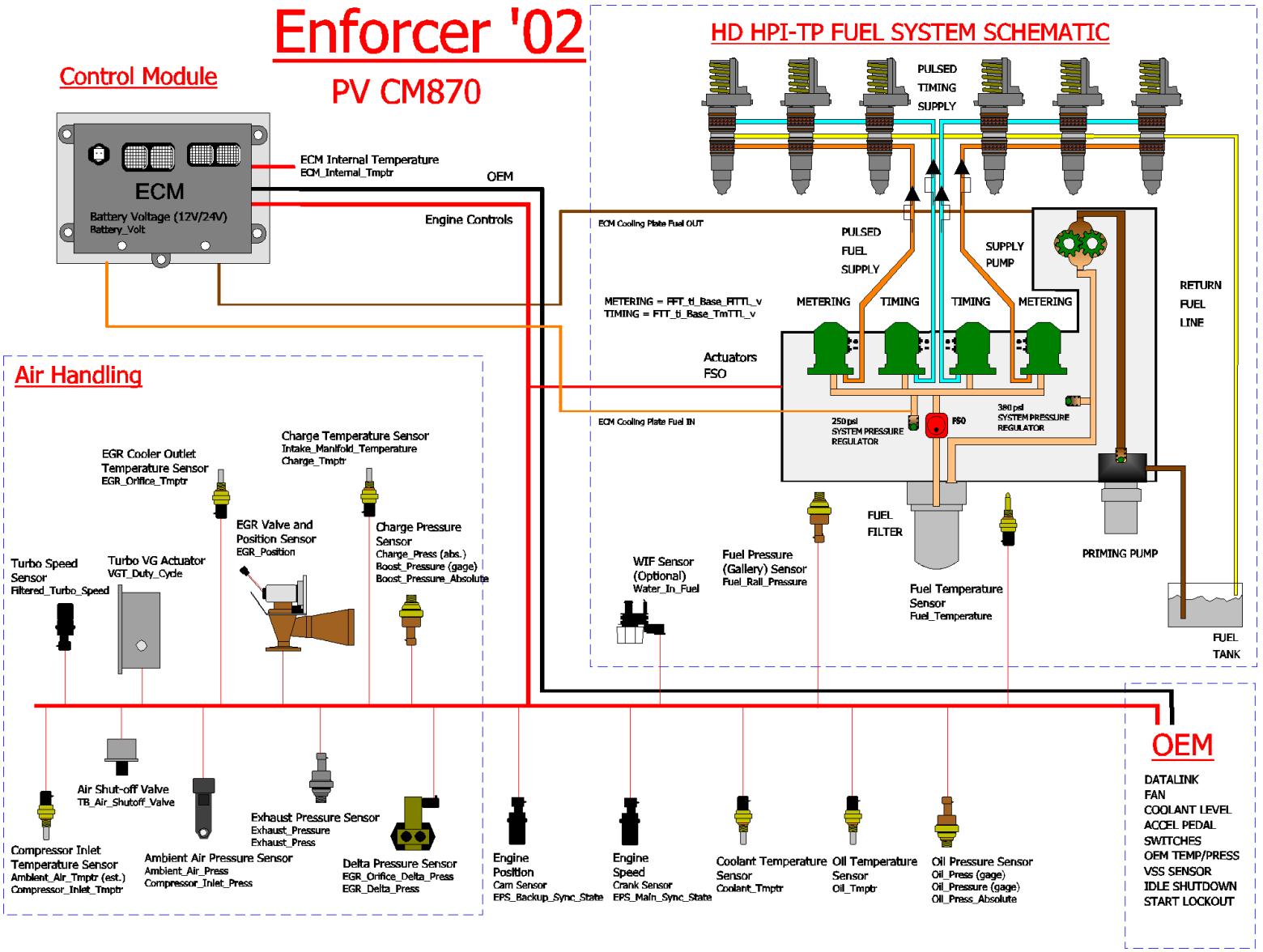
CM870 Control System – Air Handling EGR Valve / VG Turbocharger Controls:



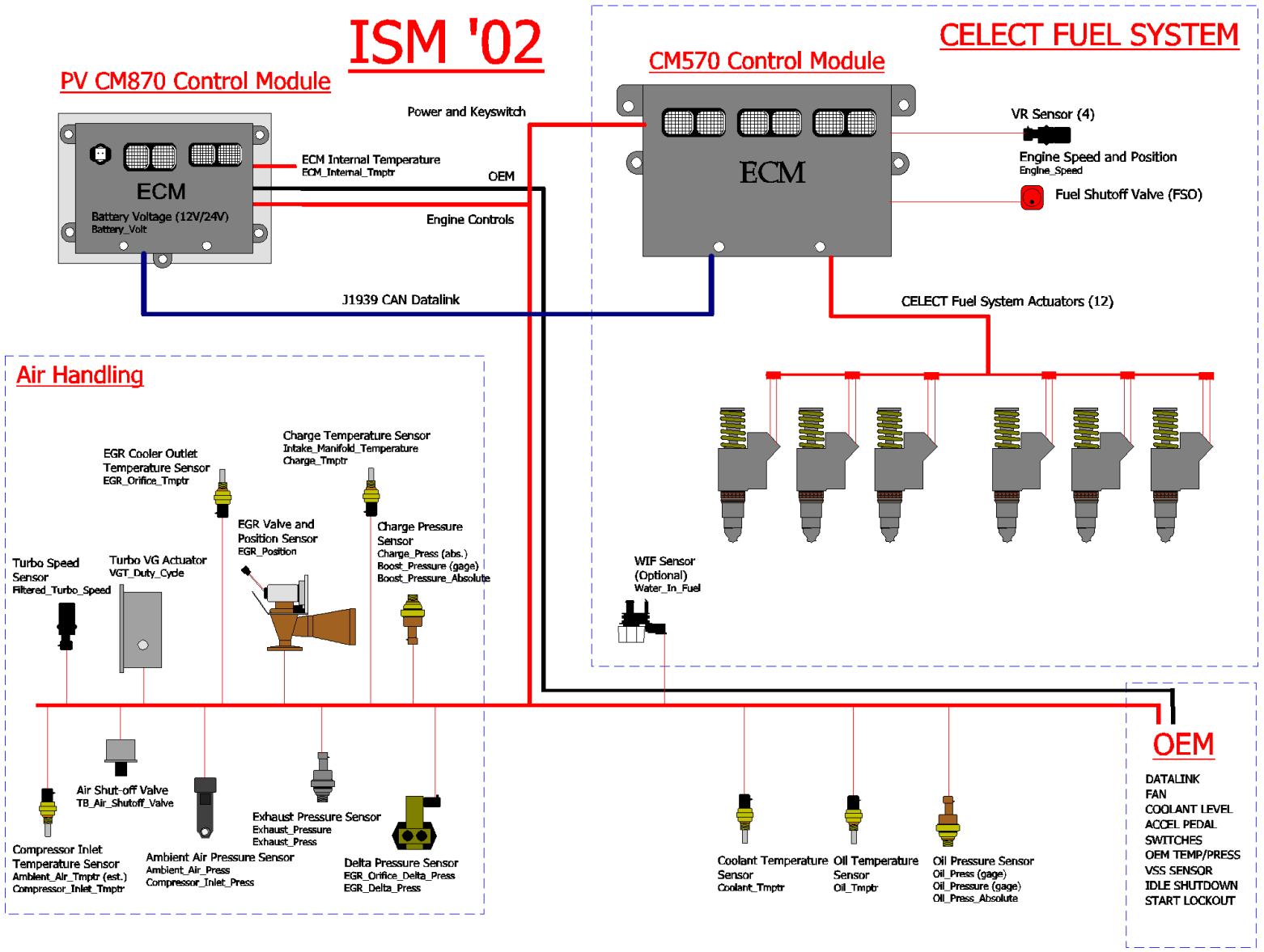
CM870 Control System – Ndot Governor Controls:



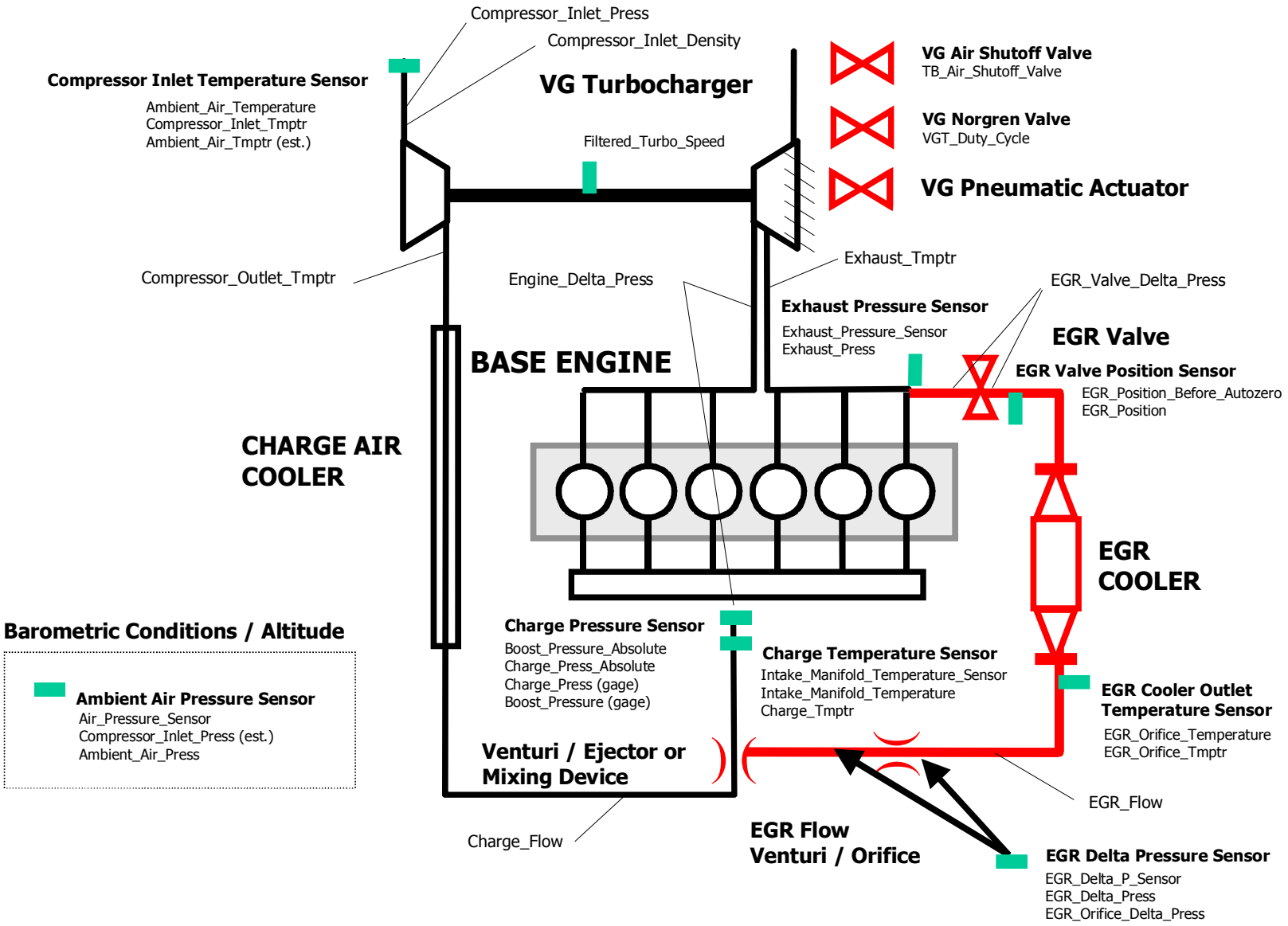
CM870 Sensor Interfaces (ENFORCER Engine):



CM870 Sensor Interfaces (ISM `02 Engine):

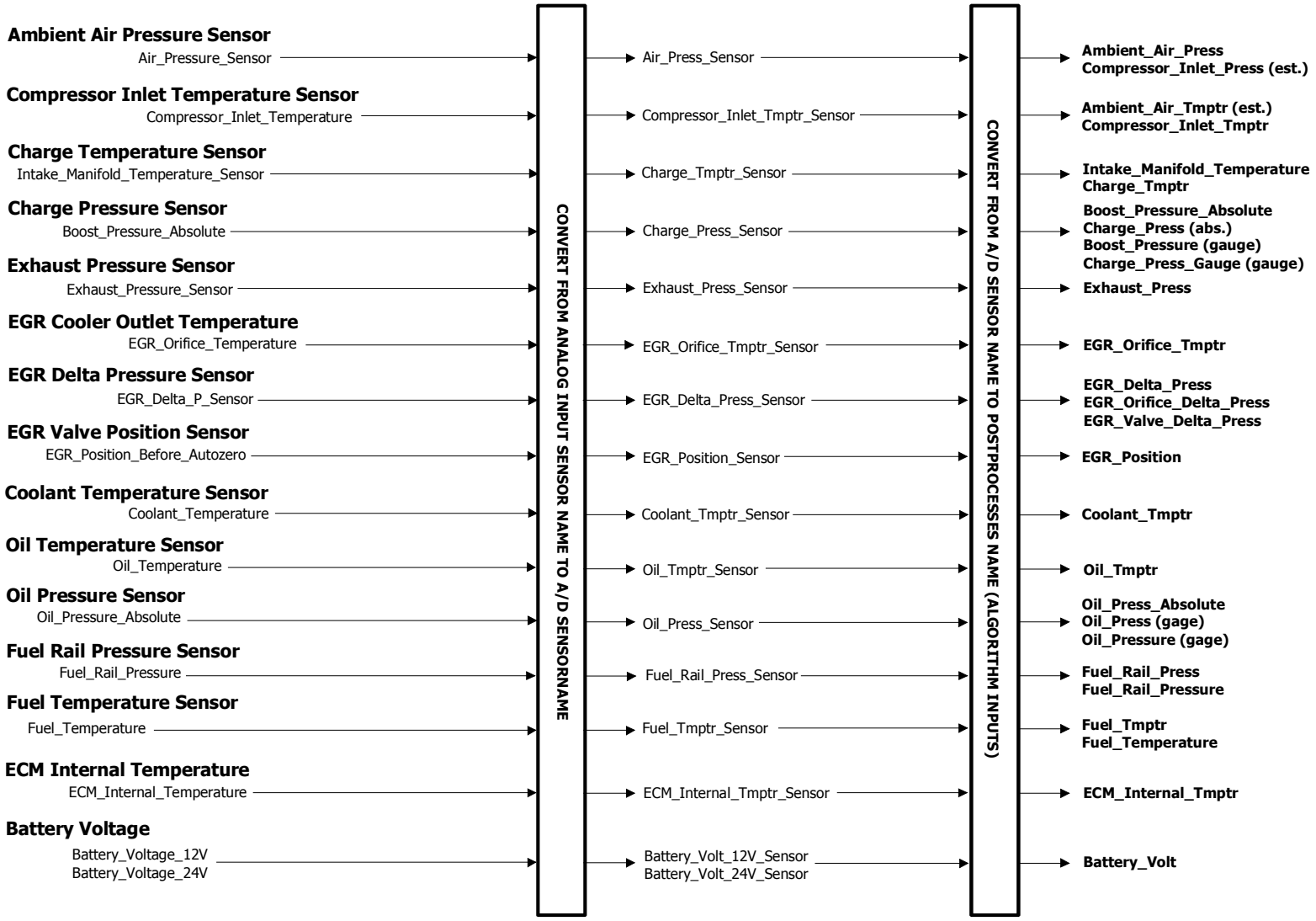


CM870 Air Handling Control System:

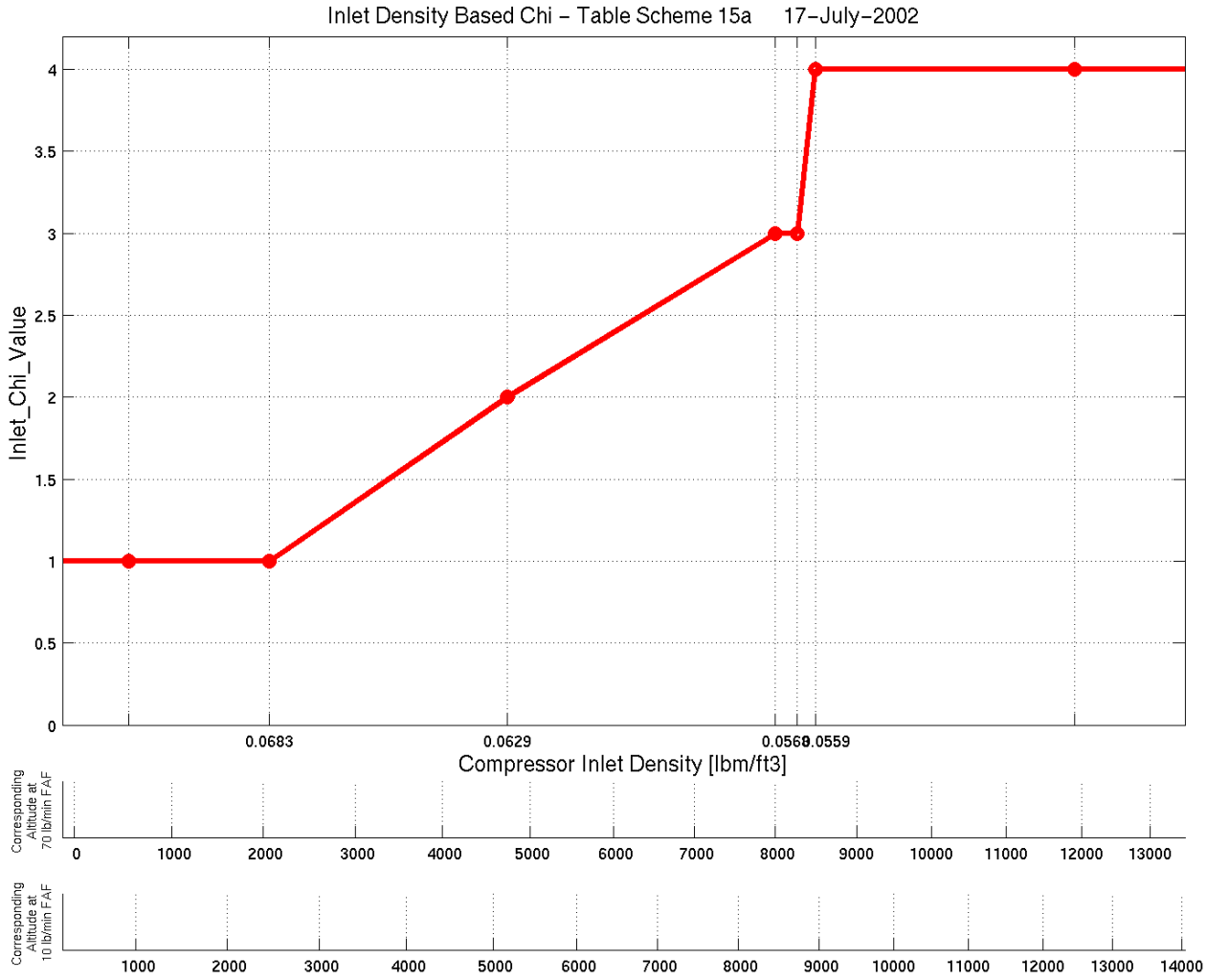


A/D Sensor Input System Name Configuration:

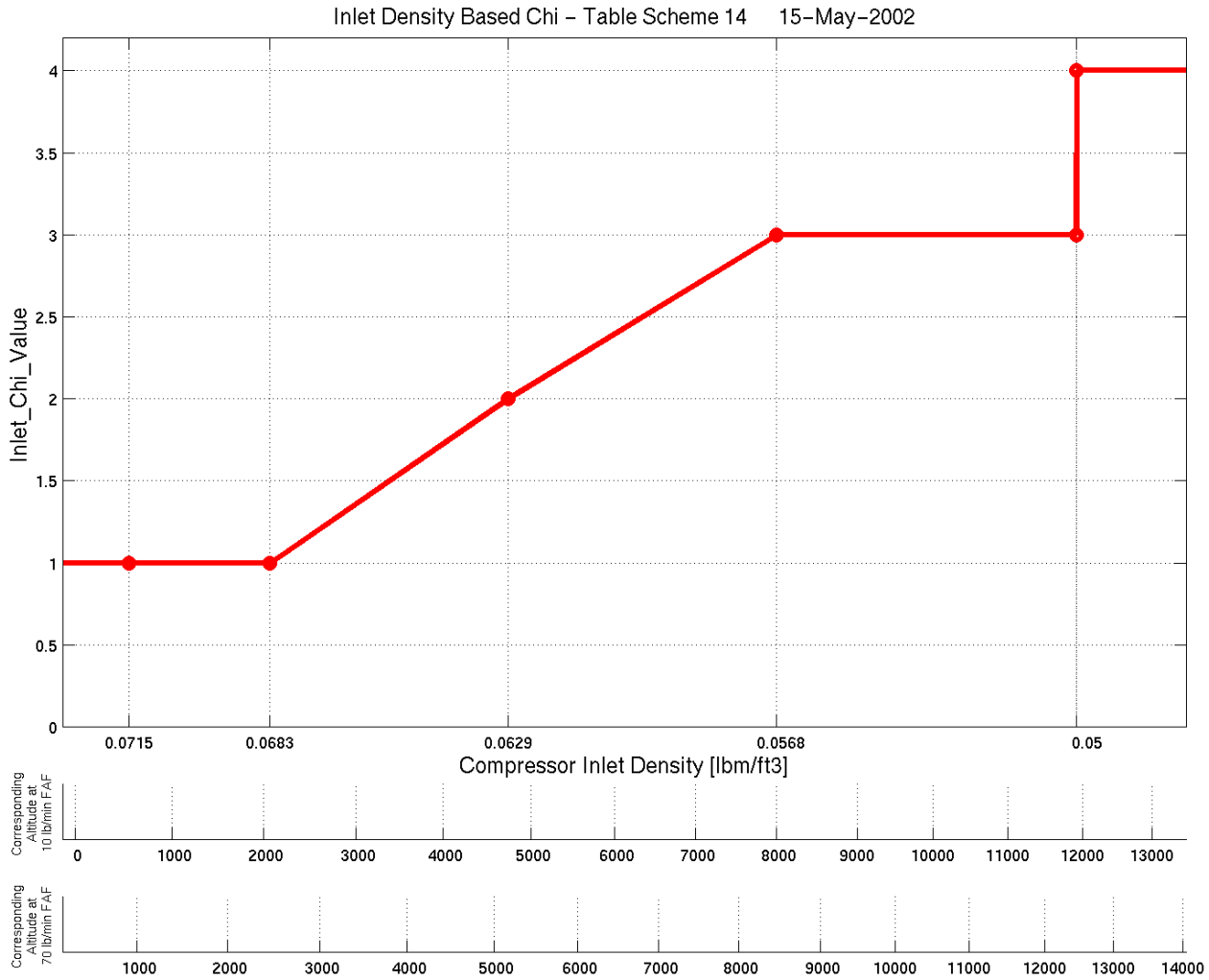
ANALOG TO DIGITAL (A/D) SENSOR INPUT SYSTEM NAME CONFIGURATION



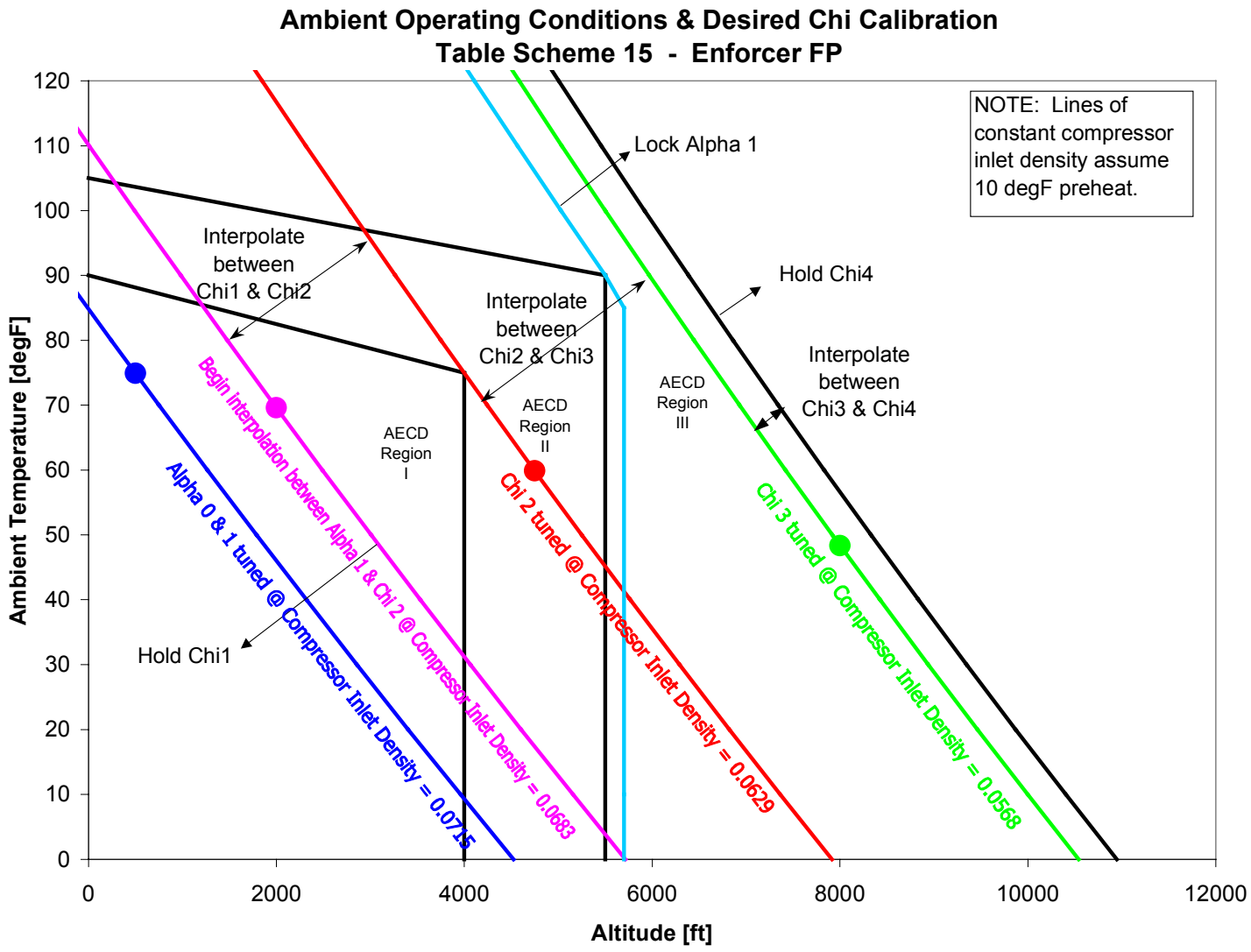
Inlet Density Chi – Chi Value Determination (Enforcer '02 Full Production Engines):



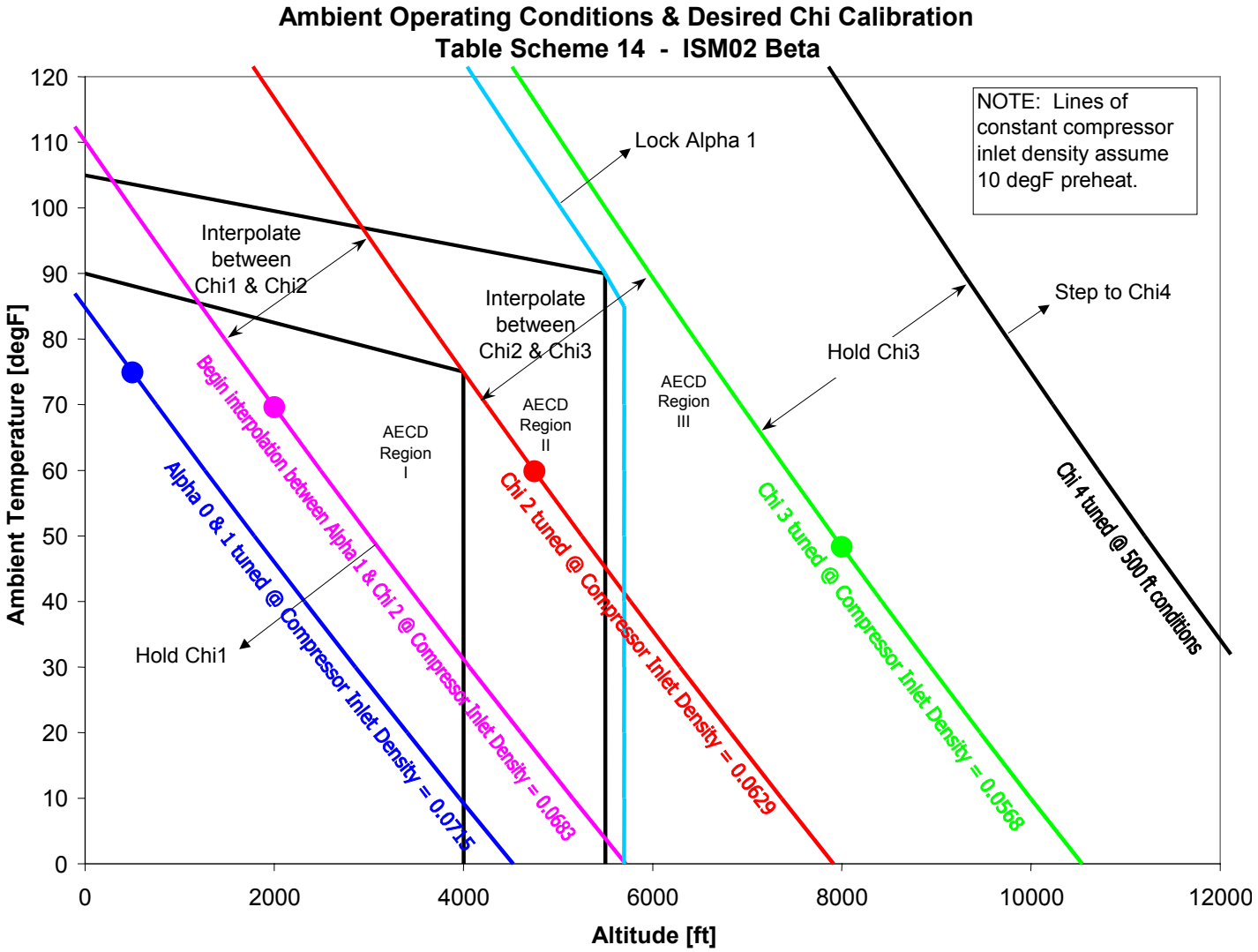
Inlet Density Chi – Chi Value Determination (ISM '02 Beta Engines):



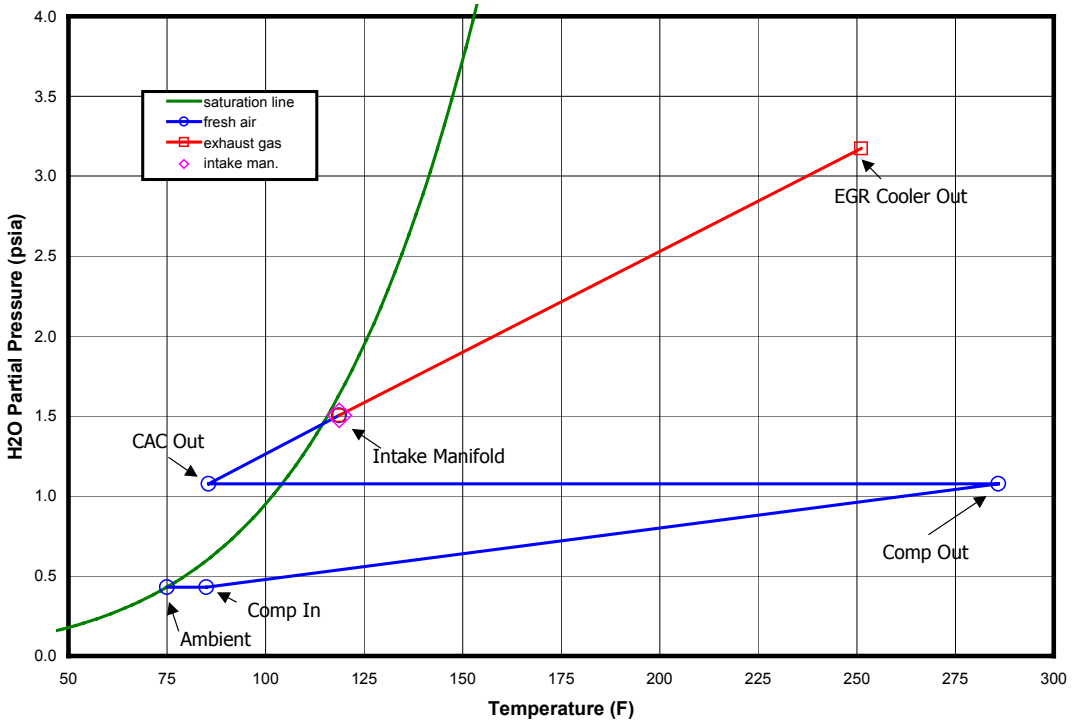
Ambient Operating Conditions – Chi Value Determination (Enforcer `02 Full Production Engines):



Ambient Operating Conditions – Chi Value Determination (ISM '02 Beta Engines):



Condensation Overview (Enforcer '02 / ISM '02):



1. measure CIT
2. estimate AAT
3. measure AAP
4. estimate Inlet Saturation Partial Pressure:
   $InletPP_{SAT}$ = f(AAT)
5. estimate Inlet Mole Fraction:
   $Inlet\mathbf{X}_{H2O}$ = $InletPP_{SAT}$*RH/AAP
6. estimate Combustion Mole Fraction:
   $Comb\mathbf{X}_{H2O}$ = f(Phi, EGX)
7. estimate Charge Mole Fraction:
   $Charge\mathbf{X}_{H2O}$ = $Inlet\mathbf{X}_{H2O}$ + $Comb\mathbf{X}_{H2O}$
8. measure IMP
9. estimate Charge Partial Pressure:
   ChargePP = $Charge\mathbf{X}_{H2O}$ * IMP
10. measure IMT
11. estimate Charge Sat. Partial Pressure:
    $ChargePP_{SAT}$ = f(IMT - margin)
12. compare to ChargePP to $ChargePP_{SAT}$

CUSTOMER / DRIVER SURVEY

Questions intended to encourage feedback on engine performance. Make record of vehicle configuration, engine model rating, transmission, axle, etc. Where possible use open ended questions to solicit driver feedback.

Customer Information

Driver Name: _____

Owner / Operator ☐ YES ☐ NO Unit #: _____

Fleet Driver ☐ YES ☐ NO Fleet Name: _____

Years of Driving Experience: _____

Other Engine(s) Driven or Familiar With: _____

Engine Model / Rating / ECM Calibration (if known): _____

How Long Have You Driven With This Engine?: _____

Base Location: _____

Typical Route: (Check all that apply)

☐ Local Delivery ☐ Mountainous

☐ Interstate ☐ Hilly Terrain

☐ City ☐ Flat Terrain

☐ Rural ☐ Dirt / Gravel Roads

☐ Off-Road ☐ Snow / Ice Covered Roads

Approx. Gross Vehicle Weight: _____

Truck Model / Year: _____

Transmission Make and Model: _____

Number of Gears: _____ Automatic / Automated Transmission? _____

Power Train Data: Rear Axle Ratio: _____

Tire Size: _____

Clutch Make / Model: _____

Auxiliary Devices: _____
(ex. Anti-Lock Brakes, Anti-Slip, PTO, Turbo-Conveyor, etc.)

CM870 COMMON APPROACH TO CONTROL SYSTEM DIAGNOSTICS

Typical Driving Techniques

Do you normally use the clutch when shifting? _____

What engine speed do you normally use to upshift? _____

What engine speed do you normally use to downshift? _____

Do you maintain Top Gear? Gear-Down? _____

What type of throttle control do you prefer to use? ☐ Automotive (Min/Max) Governor ☐ All-Speed Governor (CAT Throttle)

When do you use Cruise Control? _____

If not, do you run on the road speed governor? _____

Do you use the Smart Road Speed Governor Feature? _____

When climbing a grade do you:
Resume Cruise Control after a downshift? _____

Keep your foot on the throttle? _____

With Engine Brakes, what engine speed do you typically maintain on steep grades:

☐ 1600 – 1700 RPM ☐ 1700 – 1800 RPM ☐ 1800 – 1900 RPM

☐ 1900 – 2000 RPM ☐ 2000 – 2100 RPM ☐ Other (Specify) _____ RPM

Engine Start

Is engine cranking time acceptable? Cold Start ☐ YES ☐ NO Crank Secs _____

Hot Start ☐ YES ☐ NO Crank Secs _____

Does engine start acceptably? ☐ YES ☐ NO

Comments? _____

How long does the engine crank before it fires? _____

Does engine speed overshoot at startup? ☐ YES ☐ NO

Comments? _____

How soon does engine speed settle after the engine starts? _____

Does the engine smoke at startup? ☐ YES ☐ NO

If yes, is smoke: ☐ BLUE ☐ WHITE

Ambient Temp _____ deg Fahrenheit

How does the engine exhaust appear? _____

Is throttle response noticed after startup? Cold Start? ☐ YES ☐ NO

Hot Start? ☐ YES ☐ NO

How well does the engine respond to throttle motion after startup? _____

Comments? _____

Engine Idle

Idle speed setting used _____ RPM Idle Time (Driver Estimate) _____ % ECM Idle Time _____ %

Does the engine idle smoothly? ☐ YES ☐ NO

Does the engine surge at idle? ☐ YES ☐ NO

Does the idle increment/decrement switch operate acceptably? ☐ YES ☐ NO

Does the engine idle at desired speed? ☐ YES ☐ NO

How would you describe the engine at idle speed in terms of:

Sound? _____

Vibration? _____

When do you use the Idle Increment / Decrement (Idle Adjust) Feature? _____

What idle speed do you prefer? RPM

Does idle undershoot when coming off higher RPM engine operation? ☐ YES ☐ NO

Comments? _____

Is there any smoke during idle? ☐ YES ☐ NO

If yes, is smoke: ☐ BLUE ☐ BLACK ☐ WHITE

Ambient Temperature: _____ deg Fahrenheit

Comments? _____

Engine PTO Operation

PTO set speed used _____ RPM PTO Time (Driver Estimate) _____ % ECM PTO Time _____ %

When do you use PTO? _____

What PTO set speeds do you prefer? _____

Does the PTO operate smoothly? ☐ YES ☐ NO

Does the engine surge on PTO? ☐ YES ☐ NO

Does the PTO speed adjustment switch operate acceptably? ☐ YES ☐ NO

Does the PTO operate at desired speed? ☐ YES ☐ NO

Does PTO overshoot or undershoot when engaging PTO or changing RPM? ☐ YES ☐ NO

Comments? _____

Is there any smoke during PTO? ☐ YES ☐ NO

If yes, is smoke: ☐ BLUE ☐ BLACK ☐ WHITE

Ambient Temperature: _____ Deg Fahrenheit

Comments? _____

Clutch Engagement

In what gear do you normally launch the vehicle?

Gear:	1L	1	1H	2L	2	2H	3L	3	3H	4L	4	4H
Loaded:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Unloaded:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Bobtail:	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Do you use the throttle while releasing the clutch to launch the vehicle? ☐ YES ☐ NO

Do you let the clutch completely out before applying throttle? ☐ YES ☐ NO

Has the engine ever stalled during vehicle launch? ☐ YES ☐ NO

If YES, how often?: _____

If YES, what were the conditions when this occurred?

- On-hill Launch? ☐
- Loading Dock? ☐
- Unfamiliar with Truck / Engine? ☐
- Mud / Snow / Ice? ☐
- Released Clutch Too Fast? ☐
- Foot Slipped Off Clutch? ☐
- Chose Wrong Gear? ☐
- Other: _____ ☐

If YES, what adjustments have you made to prevent stall?

- Use Lower Gear? ☐
- Slip / Feather Clutch? ☐
- Use Throttle? ☐
- Raise Idle Speed? ☐
- Nothing? ☐
- Other: _____ ☐

Do you watch your tachometer when launching the vehicle? ☐ YES ☐ NO

If YES: Is engine speed drop excessive? ☐ YES ☐ NO Approx. RPM Drop: _____ RPM

If YES: Is engine speed overshoot excessive? ☐ YES ☐ NO Approx. RPM Overshoot: _____ RPM

Does engine speed decelerate too fast, too slow, or just right on clutch engagement? ☐ Too Fast ☐ Too Slow ☐ Just Right

Explain why: _____

Does engine speed recover (accelerate) too fast, too slow, or just right on clutch engagement? ☐ Too Fast ☐ Too Slow ☐ Just Right

Explain why: _____

Clutch Engagement (cont.)

How would you rate the overall vehicle launch performance (clutch engagement)?

- ☐ Excellent
- ☐ Good
- ☐ Acceptable
- ☐ Poor

Explain why: _____

How would you rate the engine torque (power) during vehicle launch (clutch engagement)?

- ☐ Excellent
- ☐ Good
- ☐ Acceptable
- ☐ Poor

Explain why: _____

How would you rate the engine accepting load during vehicle launch (clutch engagement) on level ground? (Check all that apply)

- ☐ Smooth
- ☐ Jerky
- ☐ Must "feather" clutch
- ☐ Engine accepts load easily
- ☐ Engine struggles to accept load
- ☐ Engine feels like it wants to stall

Comments: _____

How would you rate the engine accepting load during vehicle launch (clutch engagement) on uphill grade? (Check all that apply)

- ☐ Smooth
- ☐ Jerky
- ☐ Must "feather" clutch
- ☐ Engine accepts load easily
- ☐ Engine struggles to accept load
- ☐ Engine feels like it wants to stall
- ☐ Other _____

Comments: _____

How does this engine compare to the last engine you drove in terms of clutch engagement performance?

- ☐ Much Better
- ☐ Better
- ☐ Same
- ☐ Worse
- ☐ Much worse

Comments: _____

Overall vehicle launch (clutch engagement) comments? _____

Cruise Control

Fill in customer trim information to detail how engine is trimmed:

Road Speed Governor Upper Droop _____ MPH

Road Speed Governor Lower Droop _____ MPH

Cruise Control Upper Droop _____ MPH

Cruise Control Lower Droop _____ MPH

When do you use Cruise Control? _____

Driver Input

Can the driver easily set the desired cruise speed? ☐ YES ☐ NO

Comments? _____

Does the cruise control maintain desired set speed? ☐ YES ☐ NO

Comments? _____

When Setting ☐ YES ☐ NO Road Speed Gain MPH _____ Road Speed Loss MPH _____

On Hills ☐ YES ☐ NO Road Speed Gain MPH _____ Road Speed Loss MPH _____

Level Ground ☐ YES ☐ NO Road Speed Gain MPH _____ Road Speed Loss MPH _____

How does the engine feel and sound when:

Cresting a hill? _____

Rolling out at the bottom of a hill? _____

Does the cruise control cause the engine to surge? ☐ YES ☐ NO

At the bottom of hills? ☐ YES ☐ NO

When starting up a hill? ☐ YES ☐ NO

Does the engine respond when over-riding the cruise control with the throttle? ☐ YES ☐ NO

Does the cruise control Auto-Resume perform acceptably? (IF TRIMMED) ☐ YES ☐ NO
(Is there a noticeably time delay before resume occurs?)

Does the cruise control Auto-Resume overshoot/undershoot after clutch event? ☐ YES ☐ NO

On Hills ☐ YES ☐ NO Road Speed Gain MPH _____ Road Speed Loss MPH _____

Level Ground ☐ YES ☐ NO Road Speed Gain MPH _____ Road Speed Loss MPH _____

Engine Response

How well does the engine respond to throttle movements when:
Moving? _____

In-gear? _____

Stationary, at idle? _____

Is there noticeably delay from the time the throttle is depressed until the engine RPM or torque picks up? ☐ YES ☐ NO

Does it occur at all engine speeds or in one range of engine speed? ☐ YES ☐ NO

Range _____ RPM

Is the response predictable when the throttle pedal is depressed? ☐ YES ☐ NO
(Is it more sensitive in lower speed ranges, etc.)

Is it easy to synchronize speed during gear shifts? ☐ YES ☐ NO

Upshifts? ☐ YES ☐ NO Downshifts? ☐ YES ☐ NO

Low Speed Maneuvering

What is idle speed setting when performing parking lot maneuvers? _____ RPM

Is throttle control acceptable for low speed maneuvers (parking lots, delivery terminals, etc)

Loaded ☐ YES ☐ NO Bobtail ☐ YES ☐ NO

Is throttle control in reverse gear acceptable?

Loaded ☐ YES ☐ NO Bobtail ☐ YES ☐ NO

Is there any surge when maneuvering at low speeds? ☐ YES ☐ NO What gear? _____

How well does the engine respond during:

Low speed maneuvers? _____

Parking? _____

Braking? _____

Engine Brake in Cruise Feature

Is the delay time from the expected brake actuation until the brakes actuate acceptable? ☐ YES ☐ NO

Do the correct number of brakes actuate at the desired speed increment above cruise speed? ☐ YES ☐ NO

Does the cruise control resume correctly after the brakes have deactivated? ☐ YES ☐ NO

Does the cruise control surge when resuming? ☐ YES ☐ NO

Does the cruise control overshoot? ☐ YES ☐ NO

Does the cruise control undershoot? ☐ YES ☐ NO

Does the auto cruise braking feature cause a surge when engaging in cruise? ☐ YES ☐ NO

Does the engine brake manual shut off switch work correctly? ☐ YES ☐ NO

Does the manual brake selector switch work correctly? ☐ YES ☐ NO

EGR / VGT Control System

How does the performance of this engine compare to a previous Cummins engine you may have operated?

☐ BETTER ☐ WORSE ☐ NO CHANGE

Comments? _____

Please describe what you experience while operating/driving during:

Rapid Accels _____

Rapid Decels _____

Uphill Climb _____

Downhill Grades _____

In-City Driving _____

Highway Driving _____

Engine Idle _____

Truck Yard Maneuvers _____

During Cruise Control Events _____

During Engine Brake Events _____

Cold Engine Start _____

Approximate outside temperature _____ deg Fahrenheit

Hot Engine Starts _____

Approximate outside temperature _____ deg Fahrenheit

At Altitude _____

Approximate altitude for engine operation _____ feet

NOTES