IUMPR Data Collection Tool
Detailed Design Document
Revision 2

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Table of Contents

Overview

The IUMPR Data Collection Tool is used to gather information from Heavy Duty engines and generate a report which is used to evaluate if the engine meets requirements for the In-use Monitoring and Performance Ratios as specified by California's Heavy-Duty On-Board Diagnostic regulations.

It is intended to be used by engineers and technicians on a Microsoft Windows computer using an TMC RP1210 compliant communications adapter.

The application will have a graphical user interface and communicate with a vehicle using various modules. A series of controllers will regulate the process of the report generation.

User Interface

A graphical user interface is provided to the user with the controls to select the datalink communication adapter as well as the file used to store the collected data. The user will be provided the status indication of the progress of the data collection as well as a live (read only) view of the report in it's current state.

Mockup

Included here is a mockup of the graphical user interface. The user interface will be able to be resized up to the size of the users screen.

Adapter Selector

The adapter selector control is used by the user to select the the datalink communications adapter that will be used for communications with the engine. The user will be presented with a list of all TMC RP1210 adapters installed on the computer. The user will only be able to pick one adapter from a drop down list. Once the report generation has begun, this control will be disabled until the report generation has completed.

Report File Selector

The file selector control is used by the user to select the file for the generated report. This may be an existing file or they may create a new file. The standard Windows file selection box will be displayed to the user for this selection. After they have chosen a file this control will display the path of the file. Once the report generation has begun, this control will be disabled until the report generation has completed. If they have selected an existing file for the report, a dialog box will be displayed so they confirm the choice. The user will be able to chose any file location, whether it's local to the computer or a connected network drive. If the user chooses the wrong file, they are able to cancel their selection and no file will be selected.

Vehicle Information

This section will contain the information about the connected vehicle after the user has pressed the Read Vehicle Info button. If the VIN read from the vehicle does not match the VIN stored in the existing file (if applicable) was warning will be displayed the user. The report generation will be allowed to continue. The user may also chose a different file or vehicle before continuing. The Engine Calibrations will be displayed for informational purposes only.
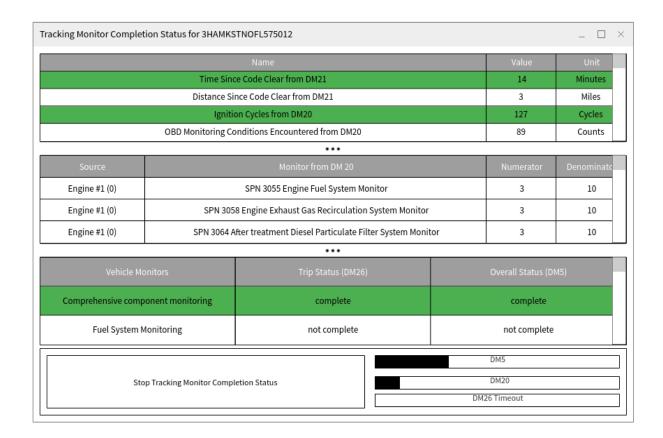
Report Control

The user will have the ability to start and stop the data gathering via the report controls. There will be four buttons:

- Generate Vehicle Data Plate
- Track Monitor Completion Status
- Collect Test Results
- Stop

Once the user has selected a communications adapter and report file, the "Generate Vehicle Data Plate" button will be enabled. After the user pushes this button and the process successfully completes, the "Track Monitor Completion Status" and "Collect Tests Results" buttons will be enabled. The "Generate Vehicle Data Plate" will be disabled unless the user restarts the application. While the processes are running, the all buttons, except the "Stop" button will be disabled. The "Stop" button can be pushed anytime to stop the executing process. Even though the "Stop" button remains enabled while the data collection process is not running, pressing it will have no effect. Pressing "Stop" will halt the current process and it will be noted in the report file that the user pressed the "Stop" button.

Track Monitor Completion Status View

When the user presses the "Track Monitor Completion Status" button, a second view will appear to provide information relevant to the monitors.

Name	Value	Unit
Time Since Code Clear from DM21	14	Minutes
Distance Since Code Clear from DM21	3	Miles
Ignition Cycles from DM20	127	Cycles
OBD Monitoring Conditions Encountered from DM20	89	Counts

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Source	Monitor from DM 20	Numerator	Denominato
Engine #1 (0)	SPN 3055 Engine Fuel System Monitor	3	10
Engine #1 (0)	SPN 3058 Engine Exhaust Gas Recirculation System Monitor	3	10
Engine #1 (0)	SPN 3064 After treatment Diesel Particulate Filter System Monitor	3	10

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Vehicle Monitors	Trip Status (DM26)	Overall Status (DM5)
Comprehensive component monitoring	complete	complete
Fuel System Monitoring	not complete	not complete

Stop Tracking Monitor Completion Status	DM5
	DM20
	DM26 Timeout

The view will remain open until the user presses the "Stop Tracking Monitor Completion Status" button. Pressing this button will complete the Track Monitor Completion Status task. The view will close and the user will be returned to the main view where they can proceed with either tracking the monitor completion status again or collecting testing results.

The view has three tables showing the DM21, DM20, DM5 and DM26 information. As information changes, the changed information will be highlighted green. For the Information table at the top, the entire row that has changed since the beginning of the session will be highlighted.

For the Ratios table in the middle, if a numerator has changed since the initial values were read when the first data plate was generated, the changed numerator will be highlighted green. If the numerator changes during the session, the entire row will be highlighted green.

For the Supported Monitors (DM26/DM5) Table at the bottom, when a monitor is complete, it will be highlighted green. If a monitor is disabled/not supported it will be highlighted red.

In the lower right corner is the communication status for the DM5, DM20 and DM26 messages. When a message is received, the progress bar will be set to the maximum value. As time passes without receiving a message, the value will decay. If the value reaches the minimum,

"Timeout" will be displayed indicating that communications has failed. Most likely the cause will be a loose adapter cable or vehicle off condition.

The tables are able to be independently resized or scrolled. Additionally, the view can be resized up to the size of the computer screen.

Current Process Progress

The progress bar will be used to display the how far along the current process is and approximately how much longer until the process completes. This won't be a completely accurate method for calculating the duration of the process. Rather it's to provide an rough idea of where the processing is. It may also be used to display status messages about the current step in the process.

Report Logger

The report logger control will provide a live preview of the report generated to that point. The user will not be able to change the report view this control. There will a scroll bar to allow the user to return to an earlier point in the report. If the user is at the bottom of the report (the most recent result) as new information is appended the report the logger will be scrolled so the latest information is continuously shown to the user.

Controllers

The Controllers will be the module responsible for generating the report. It will contain the logic to request information via the Functional Modules and to write data to the report via the File Writer as well as providing status information to the user interface. This will control the over data gather effort by calling out to the functional modules and making decisions about continuing the data gathering.

Note: Address claim will be performed by the adapter when connecting to the vehicle bus.

Vehicle Information Controller

The Vehicle Information Controller will govern the process to gather the information from the vehicle. The process will be:

1. In order to start the data gathering process, the user will be required to push the "Generate Vehicle Data Plate" button. This will only be enabled after the user has selected a communications adapter and report file.

2. The Engine Speed Module will be used to ensure the engine is communicating. If the engine is not communicating, the user will be prompted to turn the key to turn the vehicle on. The process will wait until the user starts the vehicle or presses the "Stop" button.

3. The Comparison Module will be called to compare the report file and the vehicle. If there is a mismatch, the process will abort.

4. The Banner Module will be called to generate a header for inclusion in the report. This will include the current date/time, the IUMPR header, the file access selection and file name. The vehicle datalink speed and adapter name will also be included.

5. The VIN from the [Vehicle Information Module](#) will be included in the report.

6. The Calibration Information from the [Vehicle Information Module](#) information will be included in the report.

7. The [Diagnostic Readiness Module](#) DM5 information will be included in the report.

8. The [Diagnostic Readiness Module](#) will be used to query for OBD Compliant vehicle components. The results will be included in the report.

9. The modules that respond to the [Diagnostic Readiness Module](#) will be queried by the [Vehicle Information Module](#) for their Component Identification.

10. The information about the discovered modules and file name/status will be displayed the user. The user will be required to affirm that the information is correct and to proceed with the report. The response will be noted in the report. If they chose to not proceed, the report generation will be aborted, noting the report that user aborted.

11. If a new report is being generated, the [DTC Module](#) will be used to reset any existing non-emission diagnostic trouble codes. If NACK is received, or no response, the report generation will be aborted.

12. The [Diagnostic Readiness Module](#) will be used to query vehicle for DM5s. The results will be included in the report. If there is no response, the report generation will be aborted.

13. The [Diagnostic Readiness Module](#) will be used to query vehicle for DM26s. The results will be included in the report. If there is no response, the report generation will be aborted.

14. The [Diagnostic Readiness Module](#) will be used to query vehicle for DM21s. The results will be included in the report. If there is no response, the report generation will be aborted.

15. The [DTC Module](#) will be used to request the Emission-Related Pending (DM6), Active (DM12), Previously Active (DM23) and Permanent (DM28) DTCs. The results will be included in the result. If any DTCs are received, the user will have the option to abort the report generation.

16. The [Diagnostic Readiness Module](#) will be used to query the engine for Time Since Active Codes were cleared and the results will be included in the report.

17. The [Vehicle Information Module](#) will be used to query the engine for the Total Vehicle Distance and Total Engine Hours. The results will be included in the report.

18. The Banner Module will be called to generate a footer for inclusion in the report. This will include the current date/time.

Monitor Completion Status Controller

The Monitor Completion Status Controller will govern the process to determine if OBD Monitors have completed and are ready to report results. This controller will only be exercised after the Vehicle Information Controller has successfully completed. The process will be:

1. The Engine Speed Module will be queried to ensure the engine is communicating. If the engine is not communicating, the user will be prompted to turn the vehicle on. The process will wait until the user starts the vehicle or presses the "Stop" button.

2. The Comparison Module will be called to compare the report file and the vehicle. If there is a mismatch, the process will abort.

3. The Banner Module will be called to generate a header for inclusion in the report. This will include the current date/time, the IUMPR header, the file access selection and file name. The vehicle datalink speed and adapter name will also be included.

4. The VIN from the Vehicle Information Module will be included in the report.

5. The Calibration Identification and Calibration Verification Number from the Vehicle Information Module will be included in the report.

6. The Time Since Code Clear from the Diagnostic Readiness Module will be included in the report.

7. The Monitor Tracking Module will be used to continuously track monitor completion until the user stops the process or communication fails.

8. The Diagnostic Readiness Module will be used to generate a Composite Vehicle Monitors table showing the difference between the initial DM5 and last DM5 data gathered.

9. The Diagnostic Readiness Module will be used to generate the Tabulated Performance Ratios (DM20) information showing the difference between the initial DM20 and last DM20 data gathered.

10. The Diagnostic Readiness Module will be used to query the engine for Time Since Active Codes were cleared and the results will be included in the report.

11. The Vehicle Information Module will be used to query the engine for the Total Vehicle Distance and Total Engine Hours which will both be added to the report.

12. The Banner Module will be called to generate a footer for inclusion in the report. This will include the current date/time.

Test Results Controller

The Test Results Controller will govern the process to gather the Test Results from OBD Monitors. The process will be:

1. The Engine Speed Module will be queried to ensure the engine is communicating. If the engine is not communicating, the user will be prompted to start the vehicle. The process will wait until the user starts the vehicle or presses the "Stop" button.

2. The Comparison Module will be called to compare the report file and the vehicle. If there is a mismatch, the process will abort.

3. The Banner Module will be called to generate a header for inclusion in the report. This will include the current date/time, the IUMPR header, the file access selection and file name. The vehicle datalink speed and adapter name will also be included.

4. The VIN from the Vehicle Information Module will be included in the report.

5. The Calibration Identification and Calibration Verification Number from the Vehicle Information Module will be included in the report.

6. The Time Since Code Clear from the Diagnostic Readiness Module information will be included in the report.

7. For each HD OBD Compliant Module found using the Diagnostic Readiness Module, the OBD Tests Module will be used to gather the tests results. The information from this module will be included in the report.

8. The Diagnostic Readiness Module will be used to query the vehicle for DM5s and include the results in the report.

9. The Diagnostic Readiness Module will be used to query the vehicle for DM26s and include the results in the report.

10. The Diagnostic Readiness Module will be used to query the vehicle for DM20s and include the results in the report.

11. The Diagnostic Readiness Module will be used to query the engine for Time Since Active Codes were cleared and the results will be included in the report.

12. The Vehicle Information Module will be used to query the engine for the Total Vehicle Distance and Total Engine Hours which will both be added to the report.

13. The Report File Module will be called to generate a result that will be included in the report.

14. The Banner Module will be called to generate a footer for inclusion in the report. This will include the current date/time.

Functional Modules

The Functional Modules will perform specific actions required during the report generation. This will include communication with the vehicle via the RP1210A DataBus and interpreting the results when necessary. For any modules that requests information, each request will be attempted three times with at least one second between each request.

Banner Module

This module will not communicate with the vehicle. Rather, this will be capable of generating the IUMPR Header and Footer for inclusion in the report. This header will also include the current date and time along with the version and release date of this application. The Footer will indicate the end of the report.

Diagnostic Readiness Module

The Diagnostic Readiness Module will be responsible for requesting and parsing the Diagnostic Readiness Packets: DM5, DM20, DM21, and DM26. It will be able to generate reports for the global requests of each of the packets. In addition, it will be able to return the list of packets received when requested for monitoring the results.

It will be able parse the Time SCC (DM21) in an existing report and determine if there is an inconsistency with the engine under test. That is if the Last Time SCC is greater than the current Time SCC or if the Last Time SCC has been with the last 60 minutes of the current Time SCC.

DTC Module

This module will be responsible for request the Emission-Related DTCs including:
- Pending DTCs (DM6)
- MIL-On DTCs (DM12)
- Previously MIL-On DTCS (DM23)
- Permanent DTCs (DM28)

The results from requesting these DTCs can be included in the report.

This module will also request a DM11 to clear the active DTCs. It will wait up to 5 seconds for a response (per SAE J1939/73). The module will return the results (Negative Acknowledge or Positive Acknowledgement) for inclusion in the report.

OBD Tests Module

This module will be used to gather the results of OBD tests. This will send the DM24 (SPN Support) message to request the SPNs that the controller supports. For each of those SPNs where the controller supports Scaled Test Results, a DM7 (Command Non-Continuously

Monitored Tests) message will be sent. This message will be send until the controller returns a DM30 (Scaled Test Results) message or the attempt to request the data has happened three times.

This module will also report any tests the controller supports but doesn't have data for (incomplete tests)

Vehicle Information Module

This module will be responsible for requesting or gathering information about the vehicle for inclusion in the report. This includes:

- Vehicle Identification Number, SPN 237
- Vehicle Distance, SPN 245 or SPN 917
- Total Engine Hours, SPN 247
- Calibration Verification Number, SPN 1634
- Calibration Identification, SPN 1635
- Component Identification of Make, SPN 586
- Component Identification of Model, SPN 587
- Component Identification of Serial Number, SPN 588
- Component Identification of Unit Number, SPN 233

Engine Speed Module

This module will be used to read the engine speed. If there is no engine speed present (SPN 190 is not broadcast by the engine), this module will return a failed status. This module will also provide a method to determine if the engine is running (engine speed is > 300 rpm) or not.

Report File Module

The Report File Module Modules with parse the current report to report on the quality of the process. It will count the total number of requests made to the vehicle, the number of requests that timed-out, the number of data collection log attempts and the number of Time SCC Excess Time warnings in the report. This information will then displayed to the user and included in the report.

This module will also be able to parse useful information from an existing report, such as the VIN and total number of collection logs.

Date/Time Module

The Date/Time Module will be used to generate the current date/time for the report and to read back the last Date/Time within an existing report. This module will not communicate with the vehicle.

Monitor Tracking Module

The Monitor Tracking Module will be responsible for querying the vehicle for DM5, DM20, DM26 and DM21 messages every 10 seconds. Additionally every three minutes or when the DM5 or DM20 data changes the last received packets will be written to the report. The actual interface with the vehicle will be performed by the [Diagnostic Readiness Module](#) and [Engine Speed Module](#).

In the event that the engine speed packet, DM5, DM20, DM26 or DM21 is not received, the process will end and flow will return to the caller.

Comparison Module

The Comparison Module will be responsible for comparing information from the [Report File Module](#) and the vehicle.

When the module is called to verify a report file, if an existing file is being used for the data gathering process, the validation process will be:

1. The [Date/Time Module](#) will be used to compare the existing date/times and the current date/time. The current date/time will be based upon the Windows system clock. If the existing file does not contain a date/time, the report generation will be aborted. If date/times don't increase as the existing report is read, the report generation will be aborted. If any date/time is greater than the current date/time or before Jan 1, 2017 the report generation will be aborted.

2. The [Vehicle Information Module](#) will be used to query the engine for the VIN and used to compare it to each VIN found the existing report. If any VIN in the report does not match the existing VIN, the report generation will be aborted. Additionally, if the existing report doesn't contain a VIN, the report generation will be aborted.

3. The [Vehicle Information Module](#) will be used to query the engine for the Calibration Identification and Calibration Verification Number. If any Calibration Identification or Calibration Verification Number in the existing file doesn't match the current Calibration Identification or Calibration Verification Number, respectively, or the existing file doesn't contain a Calibration Identification and Calibration Verification Number, the report generation will be aborted.

4. The [Diagnostic Readiness Module](#) will be used to query the engine for the last time the DTCs were cleared and to parse the existing file to determine the previous times since codes were cleared. If the final Time Since Codes Clear in the existing report is not found, greater than the current Time Since Code Clear or if the last Time Since Code Clear is more than 60 minutes ago when compared with the current Time Since Code Clear, an error will be reported, but report generation will continue.
    a.
5. If there are no errors parsing the existing report (if applicable) and there are no fatal errors communicating with the vehicle, the report generation process will begin. If there are errors, the user will be required to restart the application and select a different file.

Other Classes

J1939

Will handle requesting data on the databus and parsing the results according to J1939-21, J1939-71, J1939-73 and J1939DA. Retries, timeouts and handling NACKs will be centralized here.

RP1210Bus

The bus will be used to read and write packets to and from the adapter. This module will also be used to gather the list of RP1210 compliant adapters installed on the computer.

Parsed Packet

The Parsed Packet class will be sub classed to parse the specific packets used in this application. Examples are:

- Component Identification Packet
- DM11 Clear Active DTCs Packet
- DM12 MIL On Emission DTC Packet
- DM19 Calibration Information Packet
- DM20 Monitor Performance Ratio Packet
- DM21 Diagnostic Readiness Packet
- DM23 Previously MIL On Emission DT Packet
- DM24 SPN Support Packet
- DM26 Trip Diagnostic Readiness Packet
- DM28 Permanent Emission DTC Packet
- DM30 Scaled Test Results Packet
- DM5 Diagnostic Readiness Packet
- DM6 Pending Emission DTC Packet
- DM7 Command Tests Packet
- Engine Hours Packet
- Engine Speed Packet
- High Resolution Vehicle Distance Packet
- Total Vehicle Distance Packet
- Vehicle Identification Packet

Lookup Class

The Lookup class will be used to look up the human readable values for Source Address, SPN, and FMI. The values will be contained text files included in the codebase.