



Diesel Laptops, LLC – ECM Simulator

J1939 and J1708/J1587

User Manual

Revision 1.2

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2. Simulator Overview

Every engineer that works with heavy-duty vehicle databuses and Application Programmer Interfaces (APIs) needs a good source of vehicle messages that allow them to simulate vehicle conditions. Some of these standards are:

- Society of Automotive Engineers (SAE) J1708/J1587
- Society of Automotive Engineers (SAE) J1939
- Technology and Maintenance Council (TMC) RP1210
- Society of Automotive Engineers (SAE) J2534

The Diesel Laptops, LLC ECM Simulator (ECM Simulator) is a valuable tool for developing and testing Electronic Control Modules (ECMs) as well as diagnostic programs by being able to test, validate, or simulate specific scenarios.

Note: The simulator is pre-programmed and works out-of-the-box with the software that the end-user purchases. Note that the J1939 simulator is set for 250k baud.

2.1. Based on the Popular Arduino Mega 2560 Platform

The ECM Simulator is based on the Arduino Mega 2560 platform and the following items:

- Seeed Studio CAN Shield
- Copperhill Technology RS-485 5VDC (J1708) daughter board
- 3, 10k Potentiometers (POT)
- 3, Single Pole Single Throw (SPST) Switches

2.2. Source Code Option

The differentiating factor between the Diesel Laptops ECM Simulator and other ECM Simulators is that Diesel Laptops licenses the source code for the simulator so that it can be extended by the end-user!

Most simulators have proprietary hardware platforms. Because of the Intellectual Property (IP) involved in producing the hardware and firmware, those companies do not give away the source code or the schematics.

Since the Diesel Laptops ECM Simulator is based on the Arduino platform, the end-user has access to a free Integrated Development Environment (IDE) and mountains of public-domain software such as the MCP_CAN library by Cory J. Fowler. The IDE also provides a compiler and bootloader mechanism to quickly upload new code into the microprocessor.

Note: If you purchased source code for the simulator, the code is licensed and is subject to an End User License Agreement (EULA). The EULA is documented in the last chapter of this document.

2.3. ISO15765 11-Bit CAN OBDII (J1979) Simulator and Source Code

Diesel Laptops also has an ISO15765 11-bit CAN OBDII (J1979) simulator available for the ECM Simulator hardware. The software supports all J1979 OBDII "Modes" for CAN (1-4, 6-10).

Diesel Laptops also licenses access to the source code for this module.

For more information, contact Diesel Laptops or visit the Diesel Laptops website (www.diesellaptops.com). The part numbers for all modules are in the next paragraph.

2.4. Diesel Laptop Part Numbers for Hardware and Source Code

The following are the part numbers for the ECM Simulator hardware and source code. The first two items are the individual ECM Simulators only, the next two items are the ECM Simulators with respective source code, and the last item is the ECM Simulator with both sets of source code.

| Part Number | Description | Included |
|---------------|--------------------------------------|---|
| DL-ESIM1939 | ECM Simulator J1939, J1708/J1587 | Hardware and Binary Executable Only |
| DL-ESIM15765 | ECM Simulator CAN/ISO15765 | Hardware and Binary Executable Only |
| DL-ESIM1939S | ECM Simulator J1939, J1708/J1587 Kit | Hardware, Binary Executable, and Source Code |
| DL-ESIM15765S | ECM Simulator CAN/ISO15765 Kit | Hardware, Binary Executable, and Source Code |
| DL-ESIMALL | ECM Simulator Complete Kit | J1939, J1708/J1587 and CAN/ISO15765 Hardware, Binary Executables, and Source Code |

3. Hardware

3.1. Included Items

This simulator comes with the following items:

- ECM Simulator
- 110-Volt to 12-Volt Power Supply
- USB Cable
- USB Thumb Drive with User Manual, Source Code (if purchased), Arduino IDE, and CAN Library.

3.2. Connector, Knobs, and Switches

This simulator has the following items:

- 9-pin Deutsch Connector (J1939 Type I Receptacle) with the Following Pinouts:

| | | |
|-----|-------------------|--|
| ▪ A | Ground | Provided to Power Vehicle Diagnostic Adapters (VDAs) |
| ▪ B | Power(+12V) | Provided to Power Vehicle Diagnostic Adapters (VDAs) |
| ▪ C | CAN1/J1939+ | |
| ▪ D | CAN1/J1939- | |
| ▪ E | CAN1/J1939 Shield | Not Connected |
| ▪ F | J1708/J1587+ | |
| ▪ G | J1708/J1587- | |
| ▪ H | Unused | Not Connected |
| ▪ J | Unused | Not Connected |
- **Note:** Since the simulator comes with a J1939 Type I receptacle, the J1939 communications are initially set to 250k Baud. The choice of a Type I receptacle was so that older RP1210 VDAs and/or VDA cables could be used to connect to the simulator.
- Three 10kΩ Potentiometers Wired to Analog Inputs [A0], [A2], and [A4]:

| | | |
|------|---------------|---------------------------------|
| ▪ A0 | Engine Speed | (PGN 61444 / SPN 190 / PID 190) |
| ▪ A2 | Vehicle Speed | (PGN 65265 / SPN 84 / PID 84) |
| ▪ A4 | Oil Pressure | (PGN 65263 / SPN 100 / PID 100) |
- Three SPST Switches Wired to Analog Inputs [A1], [A3], and [A5]:

| | | |
|------|---------------------|--------------------------------|
| ▪ A1 | Park Brake Switch | (PGN 65251 / SPN 70 / PID 70) |
| ▪ A3 | Brake Pedal Switch | (PGN 65251 / SPN 597 / PID 65) |
| ▪ A5 | Clutch Pedal Switch | (PGN 65251 / SPN 598 / PID 85) |

4. J1939 and J1587 Messages

For messages over 8 bytes, the J1939 Broadcast Announce Message (BAM) transport protocol is being used. A simple BAM construct has been implemented in the source code.

4.1. J1939 DTCs and J1587 Fault Codes Sent

- | | | | |
|-------------|------|-------------|--------------------|
| • PGN 65226 | DM1 | • PGN 64858 | DM46 |
| • PGN 65227 | DM2 | • PGN 64857 | DM47 |
| • PGN 65231 | DM6 | • PGN 64856 | DM48 |
| • PGN 65236 | DM12 | • PGN 64855 | DM49 |
| • PGN 64949 | DM23 | • PGN 64854 | DM50 |
| • PGN 64898 | DM27 | • PGN 64853 | DM51 |
| • PGN 64896 | DM28 | • PGN 64852 | DM52 |
| • PGN 40704 | DM35 | • PGN 64721 | DM53 |
| • PGN 64863 | DM41 | • PGN 64722 | DM54 |
| • PGN 64862 | DM42 | • PGN 65229 | J1939 Freeze Frame |
| • PGN 64861 | DM43 | • PGN 40448 | J1939 DTC Counts |
| • PGN 64860 | DM44 | • PGN 64906 | J1939 J2012 DTCs |
| • PGN 64859 | DM45 | • PID194 | J1587 Fault Codes |

4.2. J1939 PGNs and J1587 PIDs Sent (Potentiometer/Switch Controlled)

- | | | |
|-----------------------|---------|---------------------|
| • PGN 61444 / SPN 190 | PID 190 | EngineSpeed |
| • PGN 65265 / SPN 84 | PID 84 | VehicleSpeed |
| • PGN 65263 / SPN 100 | PID 100 | OilPressure |
| • PGN 65251 / SPN 70 | PID 70 | Park Brake Switch |
| • PGN 65251 / SPN 597 | PID 65 | Brake Pedal Switch |
| • PGN 65251 / SPN 598 | PID 85 | Clutch Pedal Switch |

4.3. Other PGNs and J1587 PIDs Being Sent

- PGN 65217 Distances (VDHR) - Odometer (Total Vehicle Miles, Trip Miles) – High Resolution
- PGN 65262 Coolant Temp
- PGN 65269 Ambient Air Temp
- PGN 65270 Intake Manifold Temp
- PGN 65271 Voltages
- PGN 65272 Trans Oil Temp
- PGN 65259 Component Information
- PGN 65242 Software Identification
- PGN 64965 ECU Identification
- PGN 65260 Vehicle Identification Number VIN
- PGN 65253 Engine Hours Revs
- PGN 65248 Distances (VD) - Odometer (Total Vehicle Miles, Trip Miles)
- PGN 65255 Total Hours
- PGN 65259 Fuel Levels (Left, Right)
- PID 38 Fuel Level (Right)
- PID 96 Fuel Level (Left)
- PID 233 Unit Information
- PID 243 Component Information
- PID 234 Software Identification
- PID 237 Vehicle Identification Number (VIN)
- PID 244 Trip Distance - Odometer
- PID 245 Total Vehicle Distance – Odometer
- PID 246 Total Vehicle Hours
- PID 247 Total Engine Hours
- PID 249 Total Engine Revolutions

5. For Developers Who Purchase the Source Code

5.1. Need to Compile

The simulator comes fully loaded with software and there is no need to install the Arduino IDE, compile or upload any software. This section is for software developers that want to modify the software.

5.2. USB Thumb Drive

The kit will come with a USB thumb drive with:

- The source code to the simulator (J1708J1939Simulator.ino).
- Arduino IDE installation program.
- Cory J. Fowler's MCP_CAN library (MCP_CAN_lib-master.zip).
- The user manual (DL-J1939J1587Simulator-UserManual.pdf).

5.3. Step 1. Run the Arduino IDE install program.

Insert the thumb drive and run the arduino-XXX-windows.exe installation program. Installing and using the Arduino IDE is very well documented on the Arduino site.

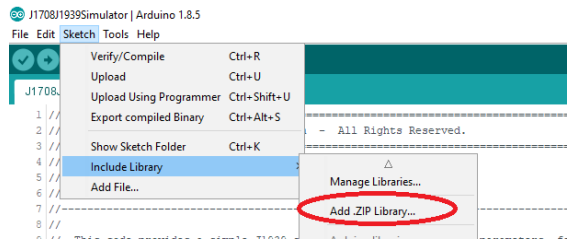
- <https://www.arduino.cc/en/Guide/HomePage>

5.4. Step 2. Install the MCP_CAN Library

If you are uncertain on how to install a ZIP file library, the following article explains in more detail:

- <https://www.arduino.cc/en/Guide/Libraries>

The easiest way to install the MCP_CAN library is from the IDE using “Sketch – Include Library – Add .ZIP Library” and then choosing the MCP_CAN_lib-master.zip file from the thumb drive.



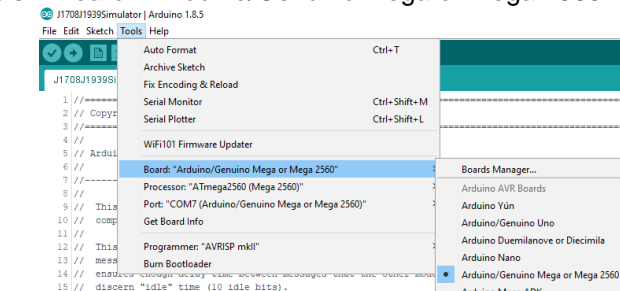
More information on the MCP_CAN library can be found at the following link:

- https://github.com/coryjowler/MCP_CAN_lib

5.5. Step 3. Open the Source Code

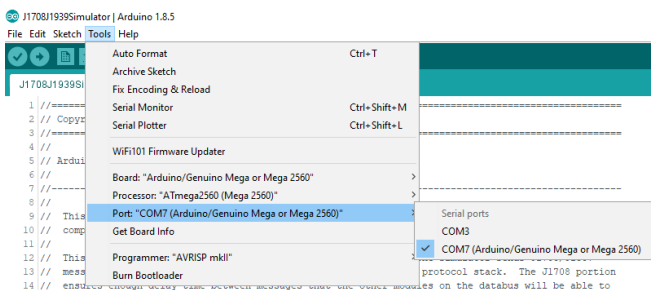
Place the source code (J1708J1939Simulator.ino) in a directory called J1708J1939Simulator and then double click the file. The IDE will open.

Select the correct board: Tools – Board – Arduino/Genuino Mega or Mega 2560



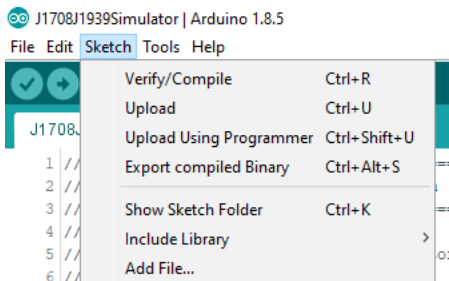
Plug in the simulator power supply and then plug the USB cord into the simulator box and into the PC (the Arduino will be recognized by Windows).

Then select the COM port to communicate with the simulator. For example: Tools – Port – COM7.



5.6. Step 4. Compile and Upload

To compile the code: Sketch – Verify/Compile. To upload the code: Sketch – Upload. The IDE will tell you if compilation and uploading was successful.



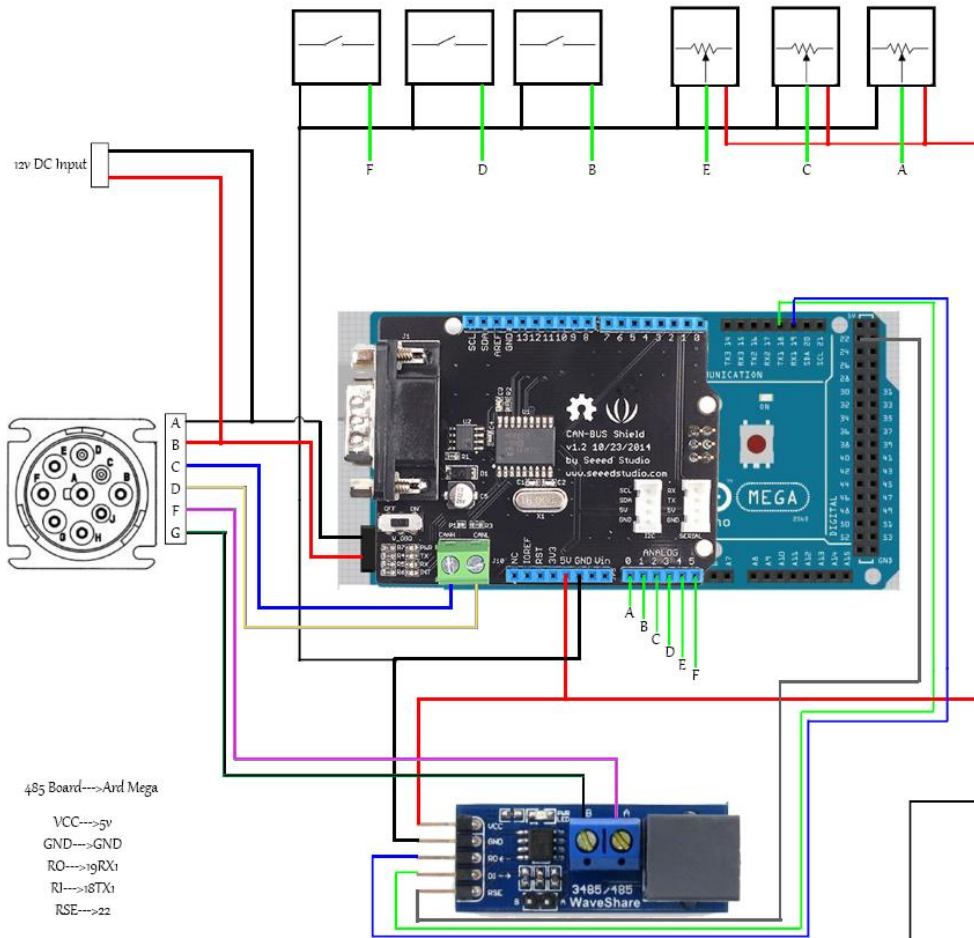
5.7. Arduino Sites, Articles, and Forums

There are many sites, articles, and forums covering the Arduino and the MCP_CAN library.

If there are issues, feel free to call Diesel Laptops at 888-983-1975. There are also hundreds of articles on the Arduino IDE on the Internet.

6. Schematic

Below is the schematic for the simulator.



Diesel Laptops, LLC
 Arduino J1939 and
 J1708/J1587 Simulator



7. Source Code End User License Agreement (EULA) – ECM Simulator

This Source Code End User License Agreement (this "Agreement") is a binding agreement between Diesel Laptops, LLC (the "Company") and the person or entity who has purchased the hereinafter described Product ("Licensee"). The Product means the Company's "J1939, J1708/J1587" or "CAN/ISO15765" variation of the Company's "ECM Simulator." The Company provides the Source Code (as defined herein) to Licensee solely on the terms and conditions set forth herein and on the condition that Licensee accepts and complies with them. "Source Code" means the Arduino firmware source code file(s) for the Product, and any and all information and materials concerning such source code disclosed by the Company to Licensee. By Licensee's acceptance and/or use of the Product or Licensee's viewing and/or use of the Source Code, Licensee agrees to the terms of this Agreement. If Licensee does not agree to the terms of this Agreement, Licensor will not and does not license the Source Code to Licensee and Licensee must not download/install/use the Source Code. Notwithstanding anything to the contrary in this Agreement or Licensee's acceptance of the terms and conditions of this Agreement, no license is granted (whether expressly, by implication, or otherwise) under this Agreement, and this Agreement expressly excludes any right, concerning any source code that Licensee did not acquire lawfully or that is not a legitimate, authorized copy of the Company's Source Code.

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 3. **No Support.** The terms of this Agreement do not entitle Licensee to receive any support or maintenance services from the Company with respect to the Source Code.
 4. **Delivery.** The Company shall provide Licensee with 1 copy of the Source Code, which shall include all information reasonably necessary for Licensee to assemble, compile, link or otherwise "build" an executable version of the Source Code.
 5. **Ownership.**
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6. **Indemnity.** Licensee agrees to defend, indemnify and hold harmless the Company (and its officers, directors, employees, and agents) from and against any damages, costs and expenses (including, without limitation, reasonable attorneys' fees and costs) arising from or relating to: (i) any third-party claims, actions or demands that the sale, distribution or other transfer of any Derivative Works by Licensee or its distributors or resellers infringes the Intellectual Property Rights of any third party; and/or (ii) the breach of this Agreement by Licensee.
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10. Termination.

10.1 The Company shall have the right to terminate this Agreement upon written notice to Licensee upon the occurrence of any of the following: (i) upon the material breach of this Agreement by Licensee, if such breach remains uncured for 10 days after written notice thereof by the Company, (ii) upon the acquisition by a Competitor of (a) all or substantially all of the assets of Licensee or (b) any majority or controlling stock, voting or other interest in Licensee, directly or indirectly, or (iii) upon Licensee making any assignment for the benefit of creditors, filing a petition in bankruptcy, being adjudged bankrupt, becoming insolvent, or being placed in the hands of a receiver, or if the equivalent of any of the proceedings or acts described in this Section occurs. "Competitor" means any company or other person or entity that is producing, manufacturing, developing or offering a product or service similar to or in competition with the Product.

10.2 Licensee shall have the right to terminate this Agreement upon 30 days advance written notice to the Company.

10.3 In the event this Agreement is terminated by the Company under Section 10.1, all licenses granted to Licensee hereunder shall immediately terminate, and Licensee shall promptly return to the Company any and all Source Code and Derivative Works, all copies thereof, and any materials incorporating any portion thereof, in Licensee's or its distributors or resellers' possession or control. Furthermore, Licensee shall promptly, and shall promptly cause its distributors and resellers to, destroy all copies of any Source Code and Derivative Works stored in any computer memory.

10.4 In the event this Agreement is terminated other than due to a breach of this Agreement by Licensee, (a) all licenses granted to Licensee hereunder shall immediately terminate, except for the license granted under Section 1(iii), which shall survive for a period of 2 years (subject to termination under Sections 10.1 or 10.2), (b) Licensee shall promptly return to the Company any and all Source Code, and all copies thereof, in Licensee's or its distributors or resellers' possession or control, and (c) Licensee shall promptly, and shall promptly cause its distributors and resellers to, destroy all copies of any Source Code stored in any computer memory. After such 2-year period, Licensee shall promptly return to the Company any and all Derivative Works, all copies thereof, and any materials incorporating any portion thereof, in Licensee's or its distributors or resellers' possession or control, and Licensee shall promptly, and shall promptly cause its distributors and resellers to, destroy all copies of any Derivative Works stored in any computer memory.

10.5 Sections 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, and 15 shall survive any expiration or termination of this Agreement.

11. Injunctive Relief. It is understood and agreed that Licensee's breach of any of the provisions of this Agreement will cause the Company irreparable damage for which recovery of money damages will be inadequate, and that the Company will therefore be entitled to seek timely injunctive relief in addition to any and all other remedies available at law or equity.

12. Export. The Source Code may be subject to US export control laws, including the US Export Administration Act and its associated regulations. Licensee shall not, directly or indirectly, export, re-export, or release the Source Code to, or make the Source Code accessible from, any jurisdiction or country to which export, re-export, or release is prohibited by law, rule, or regulation. Licensee shall comply with all applicable federal laws, regulations, and rules, and complete all required undertakings (including obtaining any necessary export license or other governmental approval), prior to exporting, re-exporting, releasing, or otherwise making the Source Code available outside the US.

13. Assignability. Licensee may not assign any rights or delegate any obligations under this Agreement without the prior written consent of the Company, which consent may be withheld or granted in the Company's sole discretion. Any assignment in violation of this provision shall be void.

14. Severability. If any term of this Agreement is found to be invalid or unenforceable, the remaining provisions will remain effective and such term shall be replaced with a term consistent with the purpose and intent of this Agreement.

15. Governing Law; Jurisdiction. This Agreement and the transactions contemplated herein will be governed by, and construed in accordance with, the laws of the State of South Carolina, without regard to conflicts of laws provisions thereof. Any legal action or proceeding arising hereunder will be brought exclusively in the state or federal courts located in South Carolina.