



# Diesel Laptops, LLC – ECM Simulator

## CAN/ISO15765 OBDII

### User Manual

Revision 1.0

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## 2. Simulator Overview

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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:

- International Standards Organization (ISO) 15765
  - Road vehicles – Diagnostic Communication over Controller Area Network (DoCAN)
- Society of Automotive Engineers (SAE) J2534
- Technology and Maintenance Council (TMC) RP1210

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 CAN 11-Bit ISO15765/OBDII simulator is set for 500k 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. “J1708/J1587 and J1939” Simulator and Source Code

Diesel Laptops also has a “J1708/J1587 and J1939” simulator available for the ECM Simulator hardware. The software supports many J1939 and J1587 parameters, including diagnostic messages.

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](http://www.diesellaptops.com)). The part numbers for all modules are in the next paragraph.

## 2.1. 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

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### 3.1. Included Items

This simulator comes with the following items:

- 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	CAN/J1939+	
▪ D	CAN/J1939-	
▪ E	CAN/J1939 Shield	Not Connected
▪ F	J1708/J1587+	
▪ G	J1708/J1587-	
▪ H	Unused	Not Connected
▪ J	Unused	Not Connected

  - The user can purchase a Diesel Laptops 9-pin to OBDII connector, however most RP1210/J2534 VDAs have a 9-pin connector that can be used.
- Three 10kΩ Potentiometers Wired to Analog Inputs [A0], [A2], and [A4]:

▪ A0	Engine Speed	(Mode 0x01 and Mode 0x02, PID 0x0C)
▪ A2	Vehicle Speed	(Mode 0x01 and Mode 0x02, PID 0x0D)
▪ A4	Engine Temperature	(Mode 0x01 and Mode 0x02, PID 0x05)
- Three SPST Switches Wired to Analog Inputs [A1], [A3], and [A5]:

▪ A1	MIL Lamp On/Off	(Mode 0x01 PID 0x01)
▪ A3	PTO On/Off	(Mode 0x01 PID 0x1E)
▪ A5	DTCs Active/Inactive	(Mode 0x03, Mode 0x07, Mode 0x0A)

## 4. OBDII Modes (Services) and Supported Parameters

There are 10 OBDII Modes (Services) defined in J1979:

Mode	Mode Description
0x01	Request Current Powertrain Diagnostic Data
0x02	Request Powertrain Freeze Frame Data
0x03	Emission-Related Diagnostic Trouble Codes
0x04	Clear/Reset Emission-Related Diagnostic Information
0x05	Request Oxygen Sensor Monitoring Test Results*
0x06	Request On-Board Monitoring Test Results for Specific Monitored Systems
0x07	Emission-Related Diagnostic Trouble Codes Detected During Current or Last Completed Driving Cycle.
0x08	Request Control of On-Board System, Test or Component
0x09	Request Vehicle Information
0x0A	Emission-Related Diagnostic Trouble Codes with Permanent Status

\* Mode 0x05 is not supported in J1979 for the CAN protocol. Mode 0x05 is implemented via Mode 0x06.

The following are the supported PIDs, TIDs, DTCs, and INFOTYPEs.

Mode	Input	Parameters
0x01		0x01 Monitor Status Since DTCs Cleared
	A1	0x01 MIL Lamp On
	A4	0x05 Engine Coolant Temperature
	A0	0x0C Engine RPM
	A2	0x0D Vehicle Speed
		0x1C OBD Requires Veh/Eng Certified
	A3	0x1E Aux Input Status
		0x41 Monitor status this driving cycle.
		0x42 Battery Voltage
		0x5F Emissions Requirements Vehicle Designed To.
0x02		0x02 DTC Causing Freeze Frame
		0x05 Engine Coolant Temperature
		0x0C Engine RPM
		0x0D Vehicle Speed
0x03	A5	DTCs "P0110", and "P0111"
0x04		Message is acknowledged, however A5 is how DTCs are toggled on/off.
0x06		0x01 Exhaust Gas Sensor Monitor Bank 1, Sensor 1
		0x02 Exhaust Gas Sensor Monitor Bank 1, Sensor 2
		0x03 Exhaust Gas Sensor Monitor Bank 1, Sensor 3
		0x04 Exhaust Gas Sensor Monitor Bank 1, Sensor 4
		0x05 Exhaust Gas Sensor Monitor Bank 2, Sensor 1
		0x06 Exhaust Gas Sensor Monitor Bank 2, Sensor 2
		0x07 Exhaust Gas Sensor Monitor Bank 2, Sensor 3
		0x08 Exhaust Gas Sensor Monitor Bank 2, Sensor 4
0x07	A5	DTCs "C0021", and "C0022".
0x08		0x01 Evaporative system leak test.
0x09		0x02 VIN
		0x04 CALID
		0x06 Calibration Verification Numbers (CVN)
		0x0A ECU Name
0x0A	A5	DTCs "B00B7", and "B00B8".

## 5. For Developers Who Purchase the Source Code

The source code includes a rudimentary ISO15765 transport protocol for messages over 7 bytes. The transport layer was tested against Diesel Laptops' PF-Diagnose and Dearborn Group's DG Diagnostics applications.

### 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 (OBDIISimulator.ino).
- Arduino IDE installation program (arduino-xxx-windows.exe).
- Cory J. Fowler's MCP\_CAN library (MCP\_CAN\_lib-master.zip).
- The user manual (DL-OBDIISimulator-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.

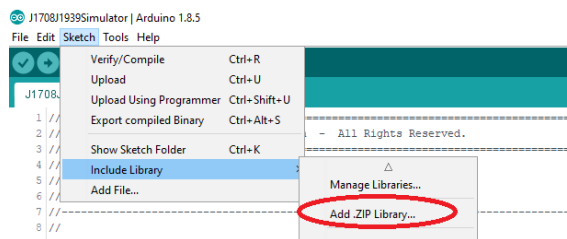
- <https://www.arduino.cc/en/Guide/HomePage>

### 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.



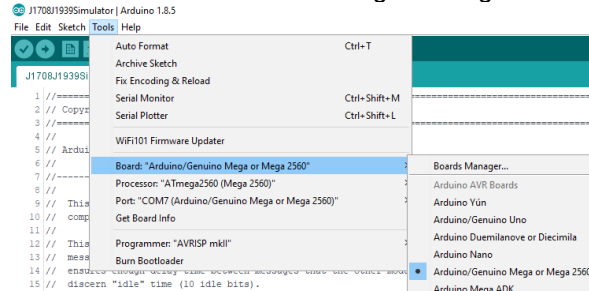
More information on the MCP\_CAN library can be found at the following link:

- [https://github.com/coryjowler/MCP\\_CAN\\_lib](https://github.com/coryjowler/MCP_CAN_lib)

## 5.5. Step 3. Open the Source Code

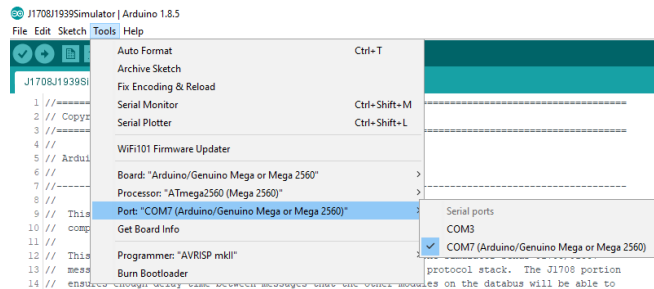
Place the source code (OBDIISimulator.ino) in a directory called OBDIISimulator and then double click the file. The IDE will open.

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



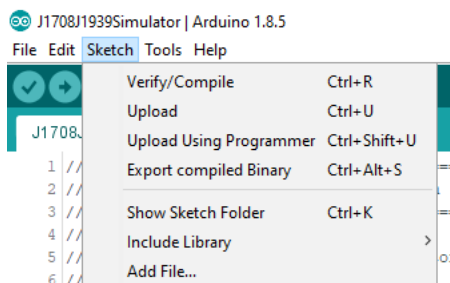
Plug in the simulator power supply and then plug the USB cord into the simulator box and into the PC (the Arduino will be recognized by Windows).

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

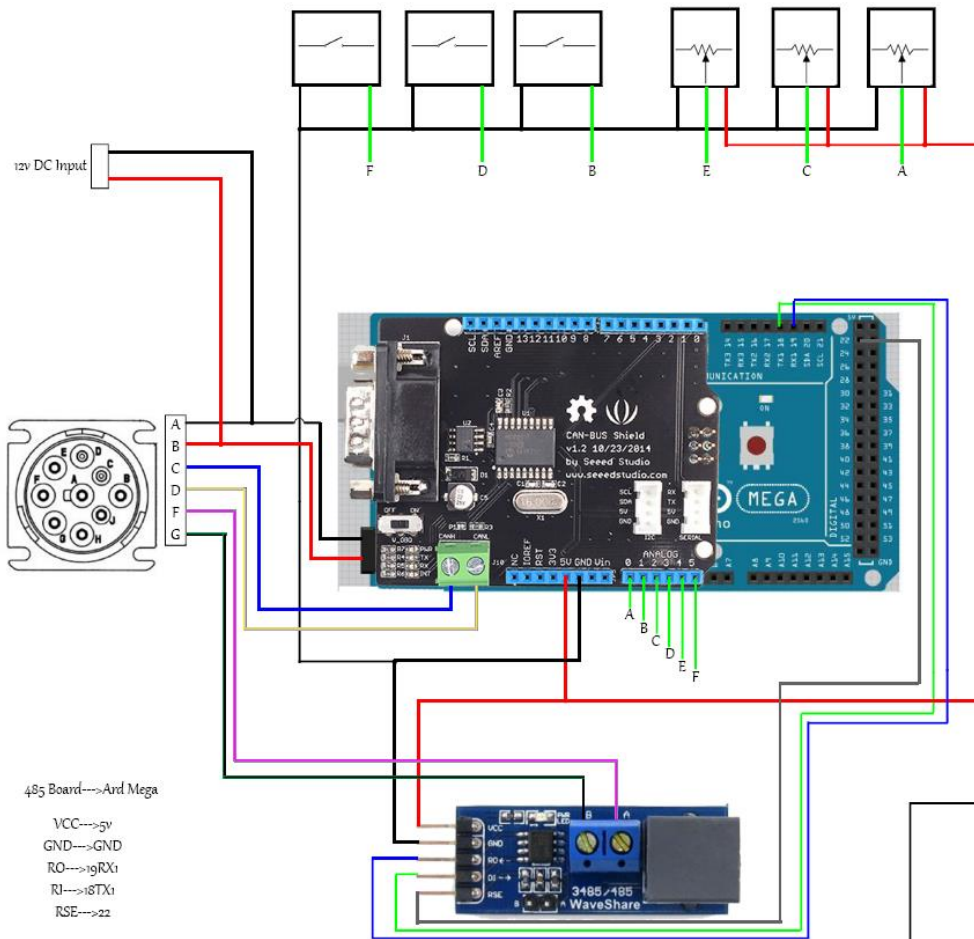
There are many sites, articles, and forums covering the Arduino and the MCP\_CAN library.

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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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.

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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.

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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.

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