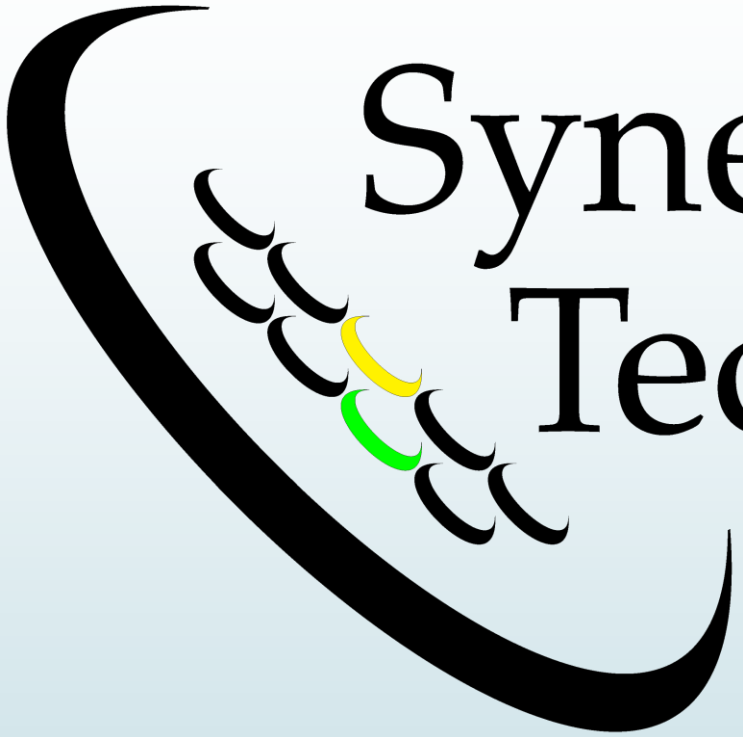


Synercon Technologies

Making it easy to obtain digital forensic data from heavy vehicle crashes.

Using and Understanding the Smart Sensor Simulator 2

Understanding the Need for the SSS2: Connecting to Electronic Control Units

A crash test conducted by Dr. Jeremy Daily at The University of Tulsa

- A working vehicle with power, ECUs and communications may not be available.
- Simulating sensors and actuators for an ECU is important to reduce new Fault Codes.
- Criminal and civil litigation would like to see reduced fault or fault-free data from ECUs.

Smart Sensor Simulator 2 Problem – Solution Fit

Current Problems

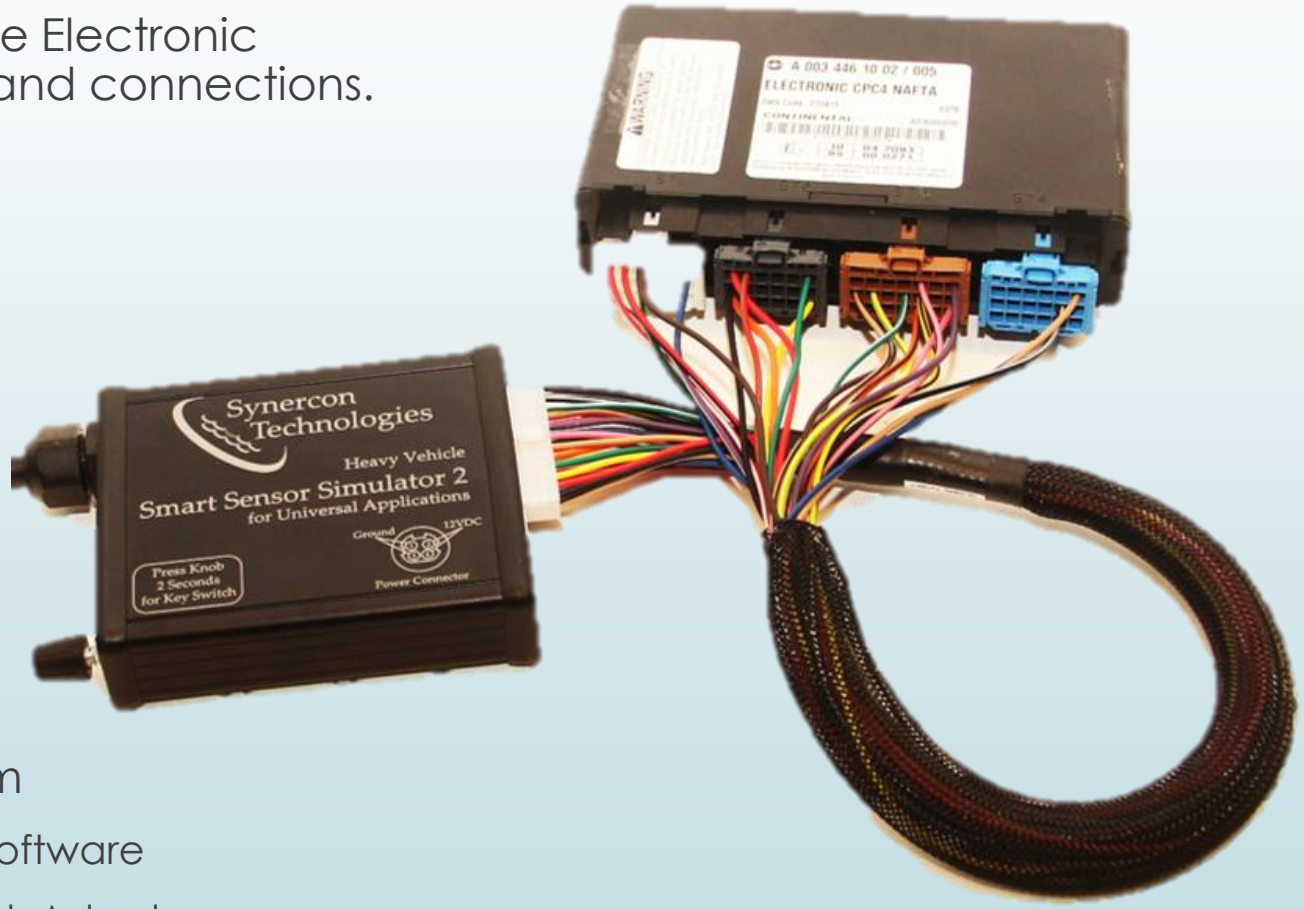
- Developing and testing with actual trucks is expensive
  - Rental/Leasing
  - Storage and maintenance
  - Limited access (one at a time)
- Stationary trucks don't give rich data sets.
- Cutting edge research risks "bricking" a truck
- Expensive wiring harnesses
- Need Fault-Free Environment

Smart Sensor Simulator Solutions

- No rental or storage fees.
- Simple USB-to-Serial command interface with a GUI
- Can rapidly adjust settings to clear or set various fault codes
- Use one truck ECU at a time
- Multiple SSS2 are easy to deploy
- Can piggy-back ECUs for complete truck build out
- The SSS2 fits in your pants pocket
- Common Molex connector interface for easy wiring

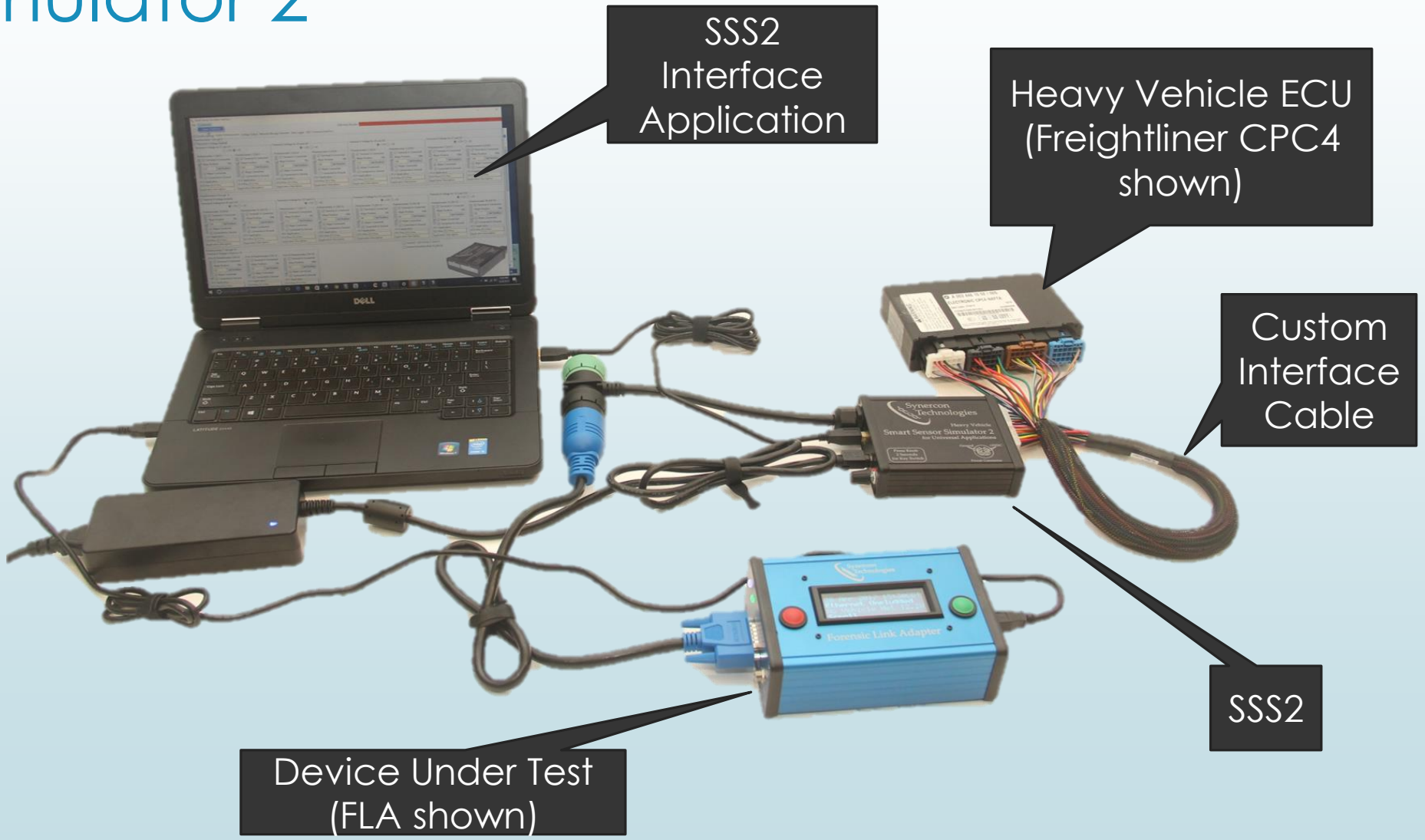
The SSS2 as a Tool in the Toolbox

- Interfacing with Heavy Vehicle Electronic Control Units requires cables and connections.
- The SSS2 Provides:
  - Power
  - Ignition Key Switch
  - Communications
    - CAN/J1939
    - J1708
    - LIN
  - Analog Sensor Simulation
  - Actuators Emulation
- Part of an Investigative System
  - Computer with Diagnostics Software
  - RP1210 Device or Forensic Link Adapter

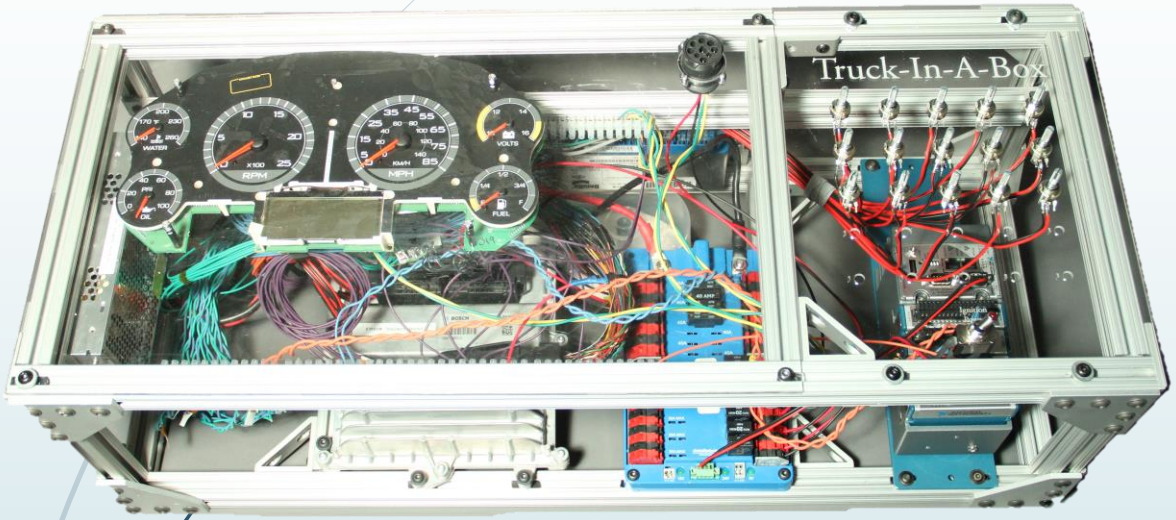


Detroit Diesel DDEC 13 Common Powertrain Controller connected to the SSS2

Truck Simulation using the Smart Sensor Simulator 2



Smart Sensor Simulator 2 Origins



DARPA/ Univ. of Tulsa
Truck In a Box
2012

Synercon Tech.
Smart Sensor Simulator
2014

Synercon Tech.
Smart Sensor Simulator 2
2017

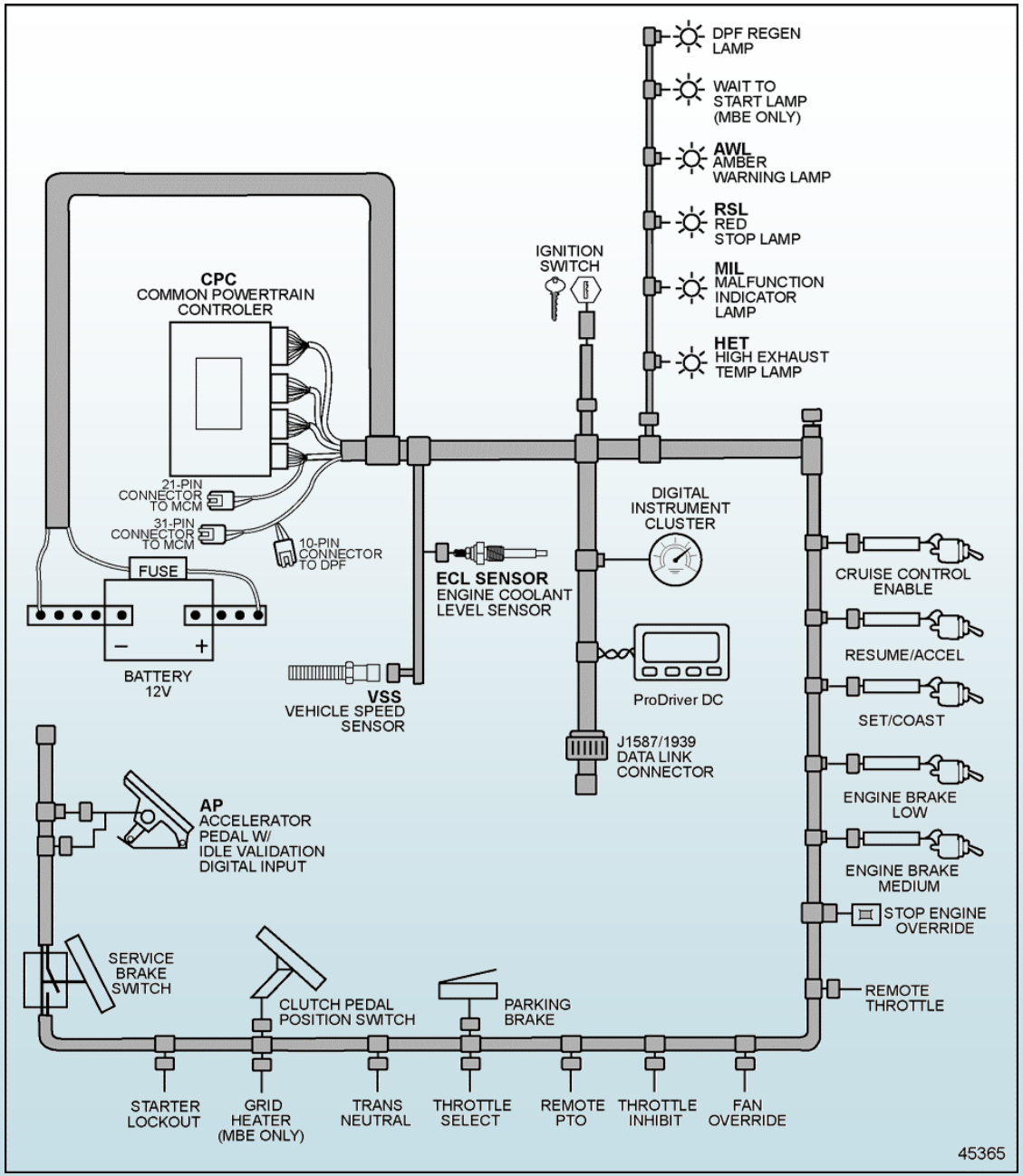
Goal: Provide researchers and investigators easy access to Electronic Control Modules outside the heavy vehicle.

The Value Proposition for the Smart Sensor Simulator 2

- "Truck-in-a-box" technology to simulate sensors and actuators on a heavy truck
- Enables fault-free downloading conditions for forensic examination.
- Establishes power and communication for electronic control units (ECUs) from heavy vehicles
- Composable networking connections to build out multiple module systems.
- Software controllable interface to adapt to multiple ECUs
- Open source hardware and software

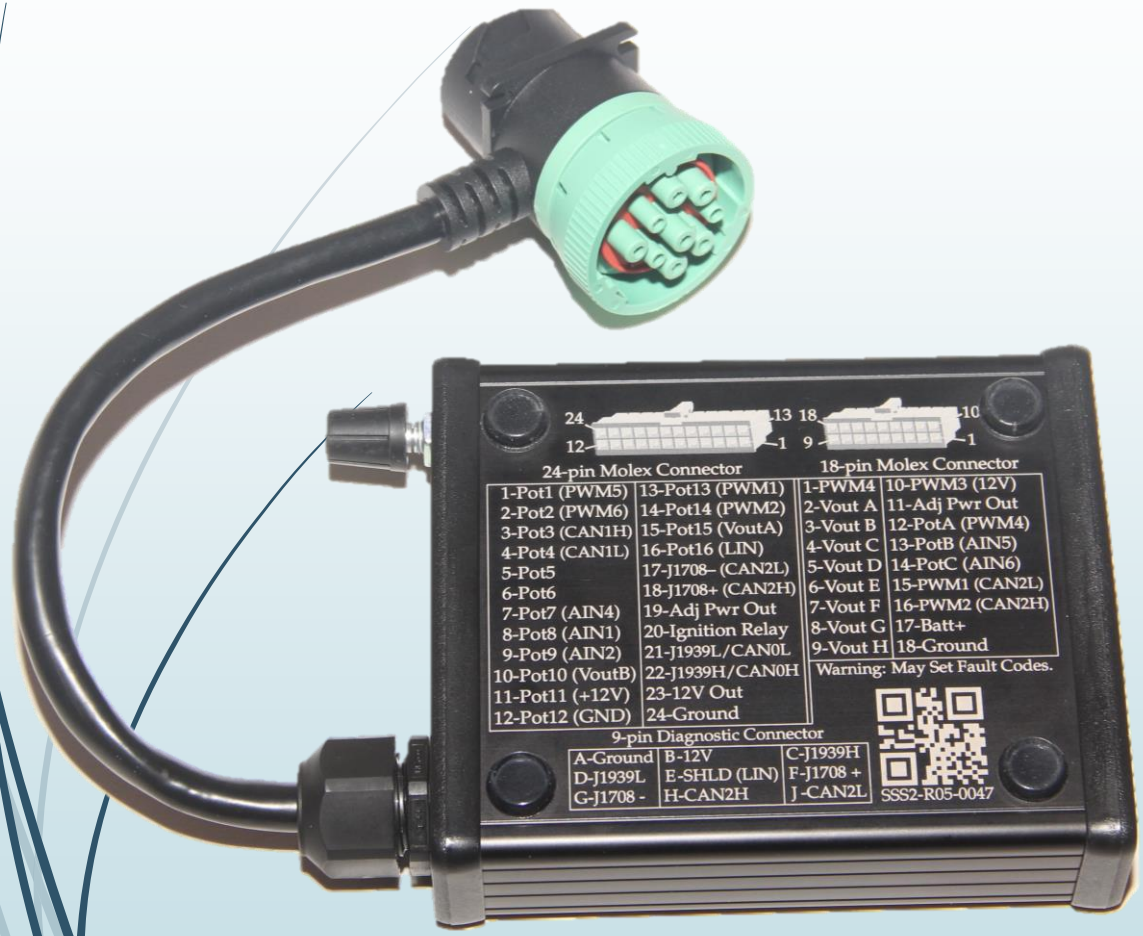
How the SSS2 Works

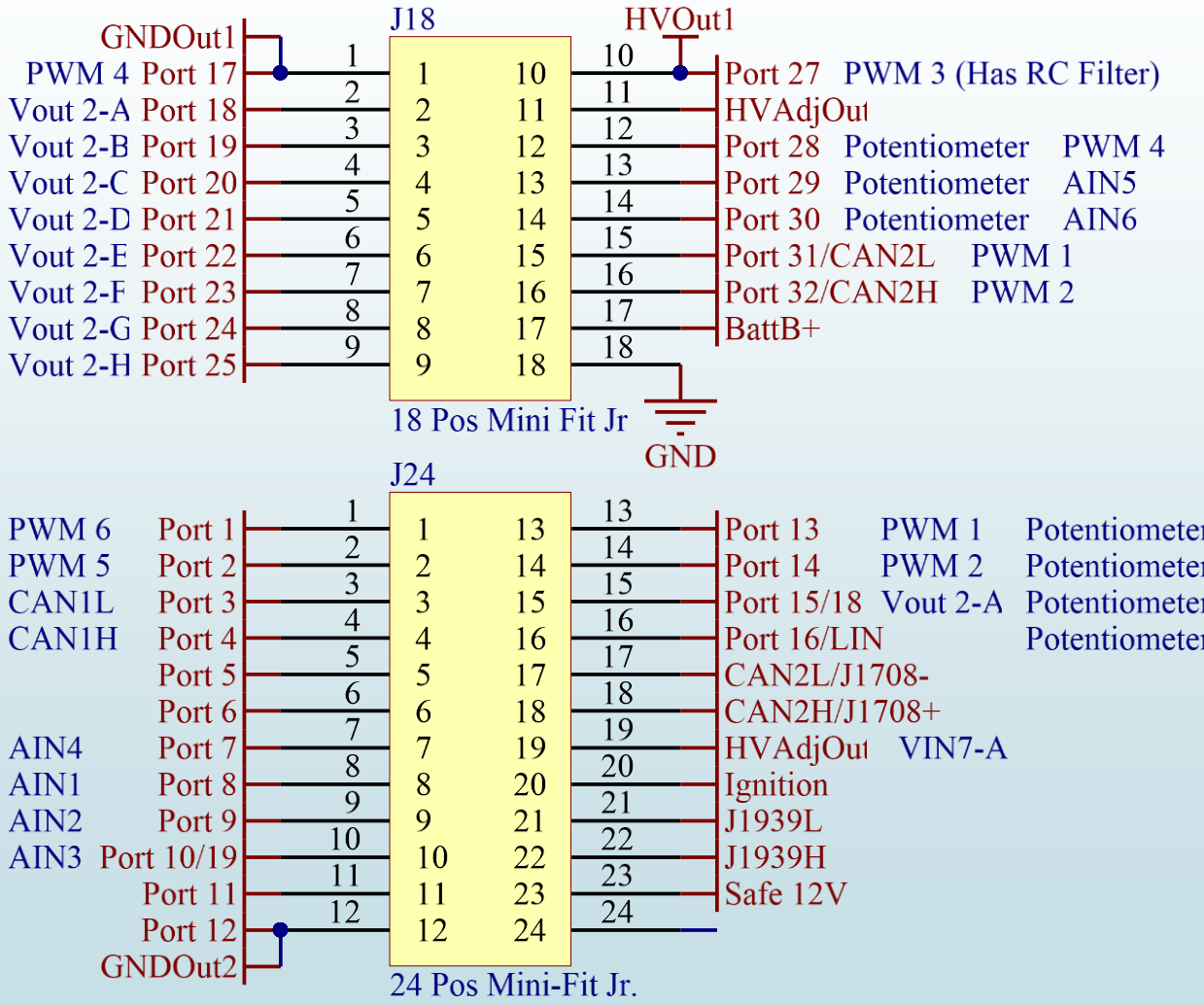
- An ECU reads electrical signals from sensor systems.
  - Two wire sensors
  - Three wire sensors
  - Actuators or Solenoids to +12V
  - Actuators or Solenoids to Ground
  - Pulse or Square Wave signals
  - Controller Area Network (CAN)
  - Switches
- The SSS2 can generate all these signal or connection types.



Schematic Layout from a DDEC VI

Smart Sensor Simulator 2 Pinouts

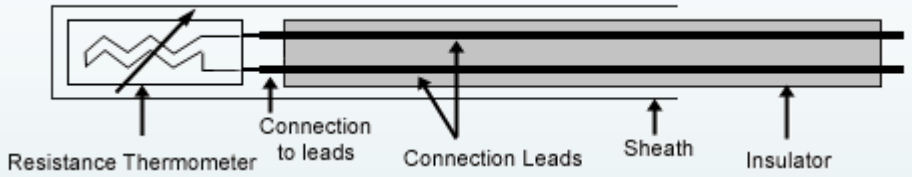




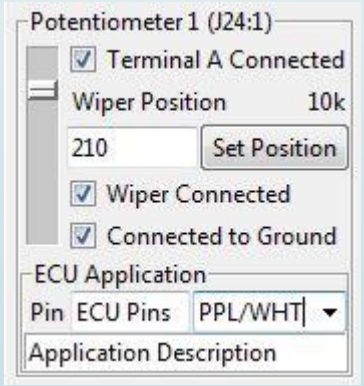
Some pins are multiplexed – they can do more than one thing.

Two Wire Sensors: Resistance Based Temperature Sensors

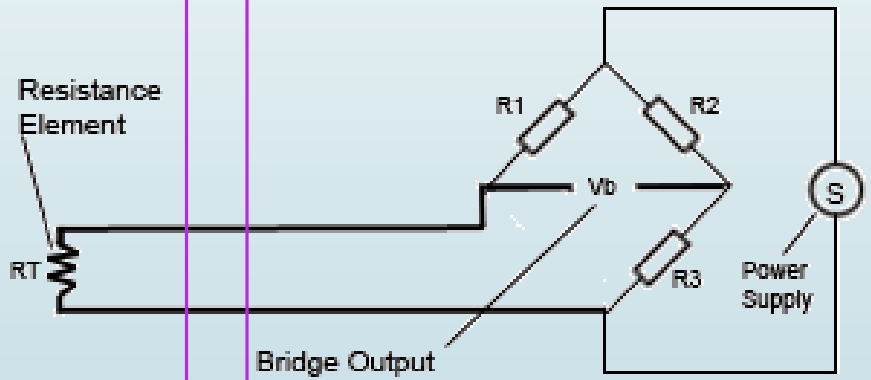
- SSS2 provides resistors to ground through digital potentiometers.



Inside the SSS2



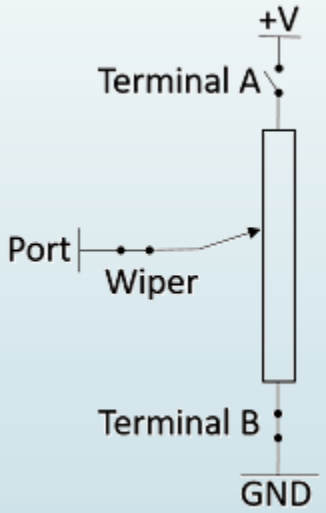
Inside the ECU

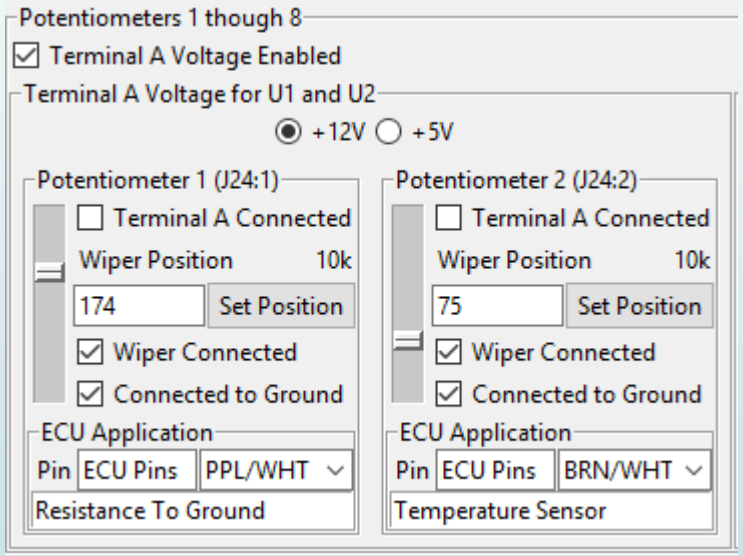


Images from Wikipedia. The original uploader was Psanderson at English Wikipedia - Transferred from en.wikipedia to Commons by JohnnyMrNinja using CommonsHelper., GFDL 1.2, https://commons.wikimedia.org/w/index.php?curid=6030373

Resistor To Ground

- Settings driven through the SSS2 Interface Application
- Terminal A is disconnected.
- Minimum Wiper to Ground resistance is about 260 ohms.
- Can be used to let the ECU detect current flow for some actuators.
- Simulate switches to ground (like Idle Validation)
- Typically use 100k potentiometers for temperature.
- Use 10k potentiometers for actuators and digital signals (pull-down resistors).

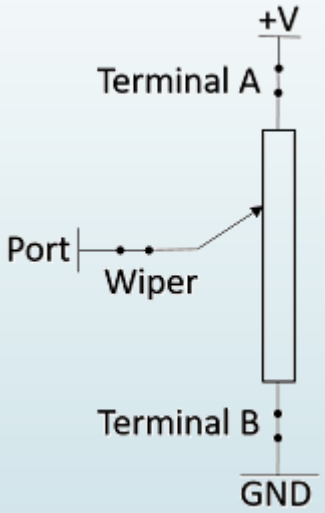


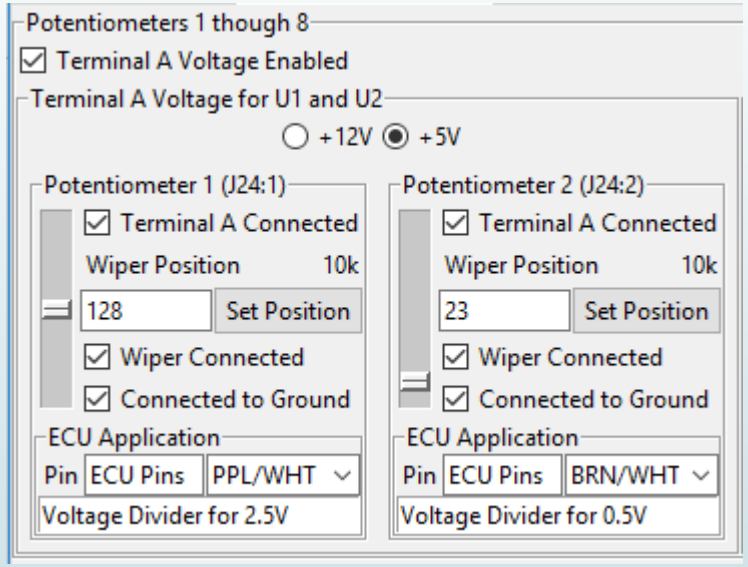


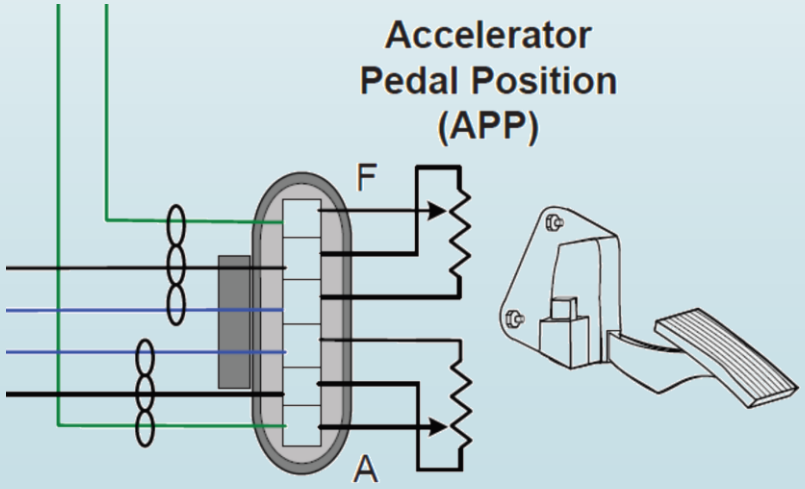
The SSS2 uses the Microchip MCP41HV51 Digital Potentiometer.
http://ww1.microchip.com/downloads/en/DeviceDoc/20005207B.pdf

Simulating a Three Wire Sensor

- Voltage dividers produce a voltage signal based the wiper position.
- Common for pressure sensors.
- Half Bridge sensors are voltage dividers.



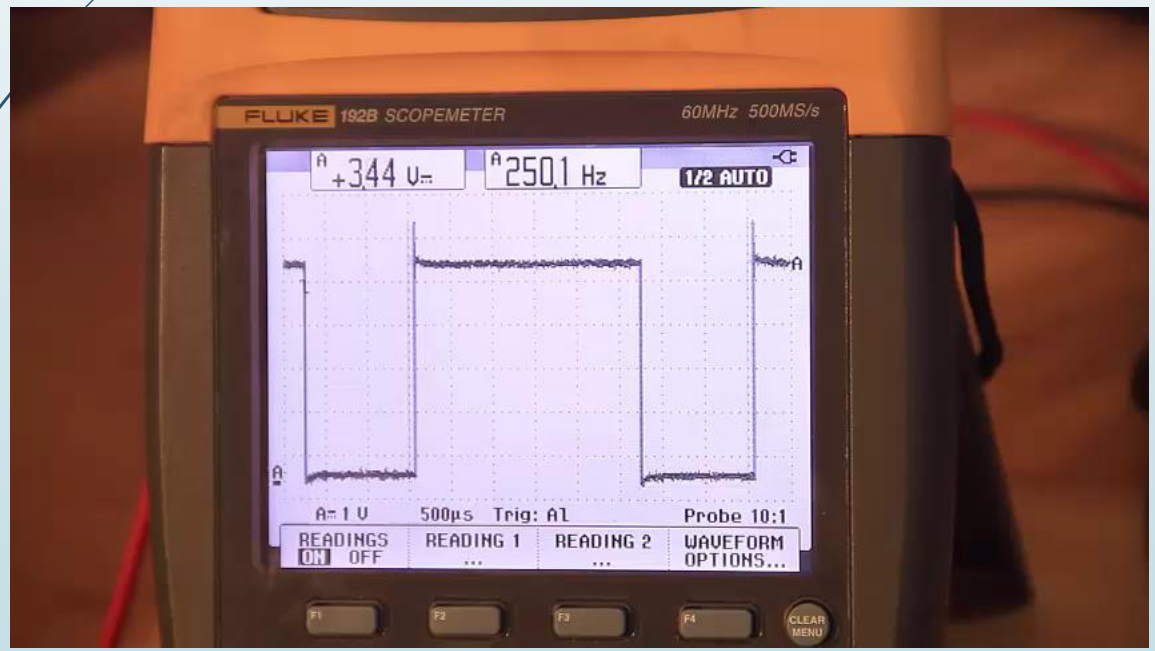


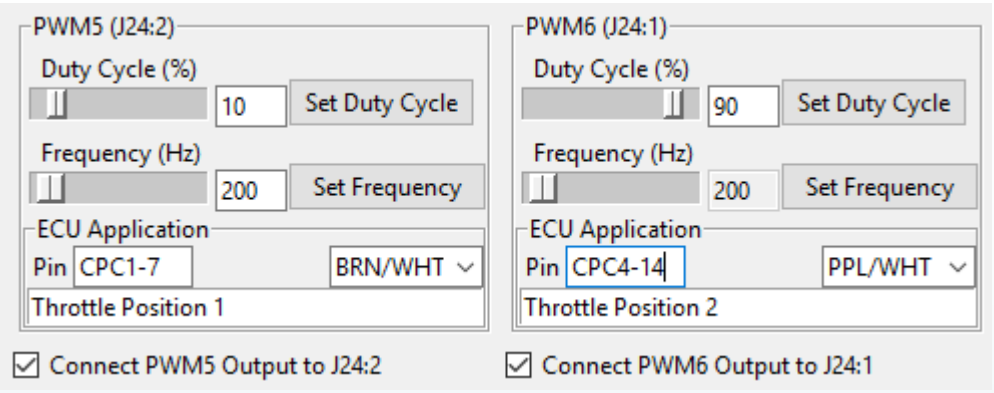


APP snip taken from the Navistar MaxxForce schematic.

Pulse Width Modulated Signals

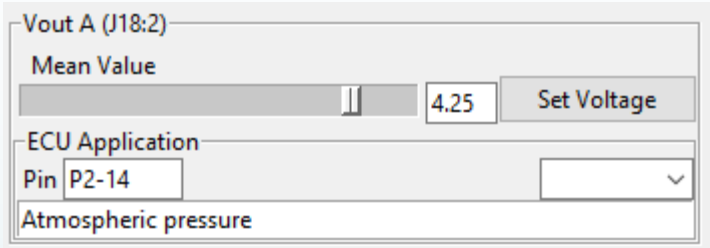
- Emulate Accelerator Pedal Positions
- Can generate speed and RPM (not for forensic use)



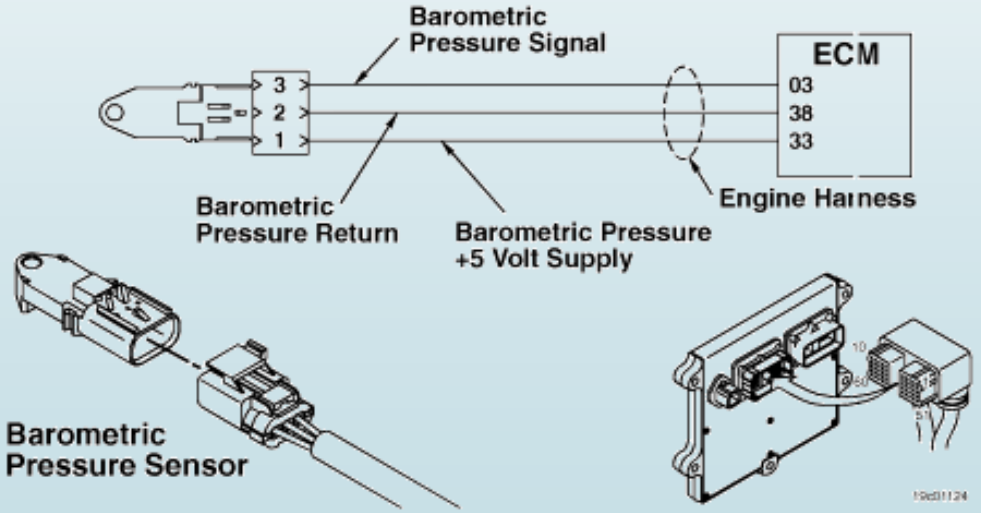


http://vanpee.vanpee.se/kataloger/Caterpillar%20Application.pdf

Analog Outputs



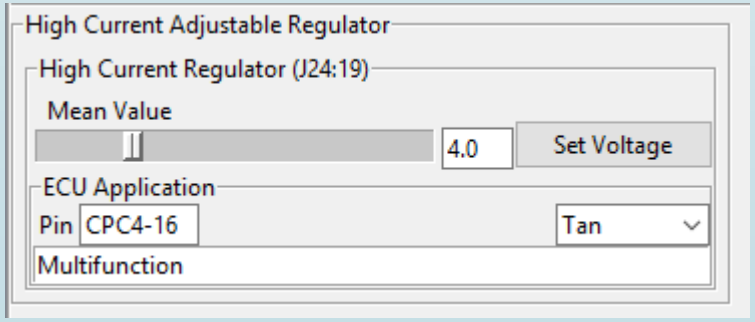
- Produce steady voltage from 0 to 5 VDC.
- Emulates pressure sensors
- If set to 0V, the ECU sees a small resistor to ground.



Snip from the Cummins CM870 Fault Information System

High Current Adjustable Regulator

- 5.0 Amp Adjustable Linear Regulator
  - 1.9V to 11VDC
  - Pins J18:11 and J24:19
- Low Power Testing
- Example: Bendix Brake Controllers
  - Power on with 8.0 VDC
  - Low Power Fault Code present
  - No existing faults are overwritten



TEXAS INSTRUMENTS

LM1084

SNVS037G – SEPTEMBER 1999 – REVISED JANUARY 2015

LM1084 5-A Low Dropout Positive Regulators

1 Features

- Available in 3.3-V, 5.0-V, and Adjustable Versions
- Current Limiting and Thermal Protection
- Output Current 5 A
- Industrial Temperature Range −40°C to 125°C
- Line Regulation 0.015% (Typical)
- Load Regulation 0.1% (Typical)

2 Applications

- Post Regulator for Switching DC-DC Converter
- High-Efficiency Linear Regulators
- Battery Chargers

3 Description

The LM1084 is a regulator with a maximum dropout of 1.5 V at 5 A of load current. The device has the same pinout as TI's industry standard LM317.

Two resistors are required to set the output voltage of the adjustable output voltage version of the LM1084. Fixed output voltage versions integrate the adjust resistors.

The LM1084 circuit includes a zener trimmed bandgap reference, current limiting, and thermal shutdown.

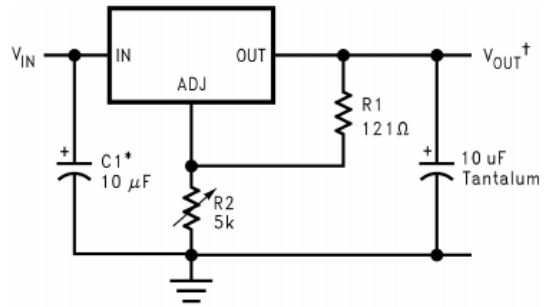
Refer to LM1085 for the 3A version, and the LM1086 for the 1.5A version.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
LM1084	TO-263 (3)	10.18 mm × 8.41 mm
	TO-220 (3)	14.986 mm × 10.16 mm

(1) For all available packages, see the orderable addendum at the end of the datasheet.

Typical Application



*NEEDED IF DEVICE IS FAR FROM FILTER CAPACITORS

$^{\dagger}V_{OUT} = 1.25V\left(1 + \frac{R2}{R1}\right)$

Adjusting the SSS2 Settings

Hard Way

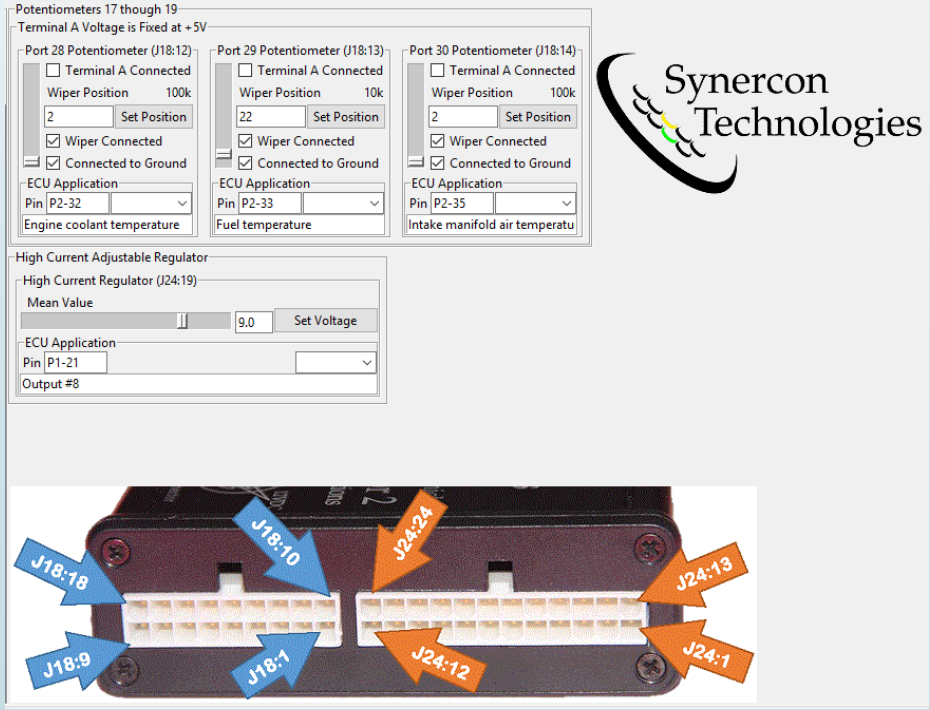
- Type in serial commands

List SSS2 Settings | Command: 16,5

```
INFO 60, Dig. Pot. 10 Terminal Connect, Port 10 (J24-10) = 3, 0 Nothing connected
INFO 61, Dig. Pot. 11 Terminal Connect, Port 11 (J24-11) = 0, 0 Nothing connected
INFO 62, Dig. Pot. 12 Terminal Connect, Port 12 (J24-12) = 0, 0 Nothing connected
INFO 63, Dig. Pot. 13 Terminal Connect, Port 13 (J18-11) = 3, 0 Nothing connected
INFO 64, Dig. Pot. 14 Terminal Connect, Port 14 (J18-12) = 7, 0 Nothing connected
INFO 65, Dig. Pot. 15 Terminal Connect, Port 15 (J24-15) = 7, 0 Nothing connected
INFO 66, Dig. Pot. 16 Terminal Connect, Port 16 (J24-16) = 7, 0 Nothing connected
INFO 67, PWM1 Connect, Port 13 (J24-13) = 1 Connected
INFO 68, PWM2 Connect, Port 14 (J24-14) = 0 Open
INFO 69, PWM3 Connect, Port 27 (J18-10) = 1 Connected
INFO 70, PWM4 Connect, Port 17 (J18- 1) = 1 Connected
INFO 71, LIN to Shield Connect, (J10- 5) = 0 Open
INFO 72, LIN to Port 16 Connect, Port 16 (J24-16) = 0 Open
INFO 73, U28 (U1-U8)  P0A Enable, (J24-1 to J24-8) = 1 Connected
INFO 74, U31 (U9-U16) P0A Enable, (J24-9 to J24-16) = 1 Connected
INFO 75, Digital Potentiometer 28 Wiper, Port 28 (J18-12) = 2, 2
INFO 76, Digital Potentiometer 29 Wiper, Port 29 (J18-13) = 22, 22
INFO 77, Digital Potentiometer 30 Wiper, Port 30 (J18-14) = 2, 2
INFO 78, Dig. Pot. 28 Terminal Connect, Port 28 (J18-12) = 3, 3 (TCON_WIPER_AND_B)
INFO 79, Dig. Pot. 29 Terminal Connect, Port 29 (J18-13) = 3, 3 (TCON_WIPER_AND_B)
INFO 80, Dig. Pot. 30 Terminal Connect, Port 30 (J18-14) = 3, 3 (TCON_WIPER_AND_B)
INFO 81, PWM 1 Frequency, Port 13 (J24-13) = 500
INFO 82, PWM 2 Frequency, Port 14 (J24-14) = 500
INFO 83, PWM 3 Frequency, Port 27 (J18-10) = 0
INFO 84, PWM 4 Frequency, Port 17 (J18-1) = 0
INFO 85, PWM 5 and 6 Frequency, Ports 1 and 2 (J24-1 and 2) = 0
INFO 86, PWM 4 Connect, Port 28 (J18-12) = 0 Open
INFO 87, PWM 5 Value, Port 2  (J24-2) = 0
INFO 88, PWM 6 Value, Port 1  (J24-1) = 0
INFO 89, PWM 5 Connect, Port 2 (J24-2) = 0 Open
INFO 90, PWM 6 Connect, Port 1 (J24-1) = 0 Open
INFO 91, CAN1 Connect, Ports 3 and 4 (J24-3 and 4) = 0 Open
INFO 92, CAN2 Connect, (J18-15 and J18-16) = 0 Open
SET 16,5
```

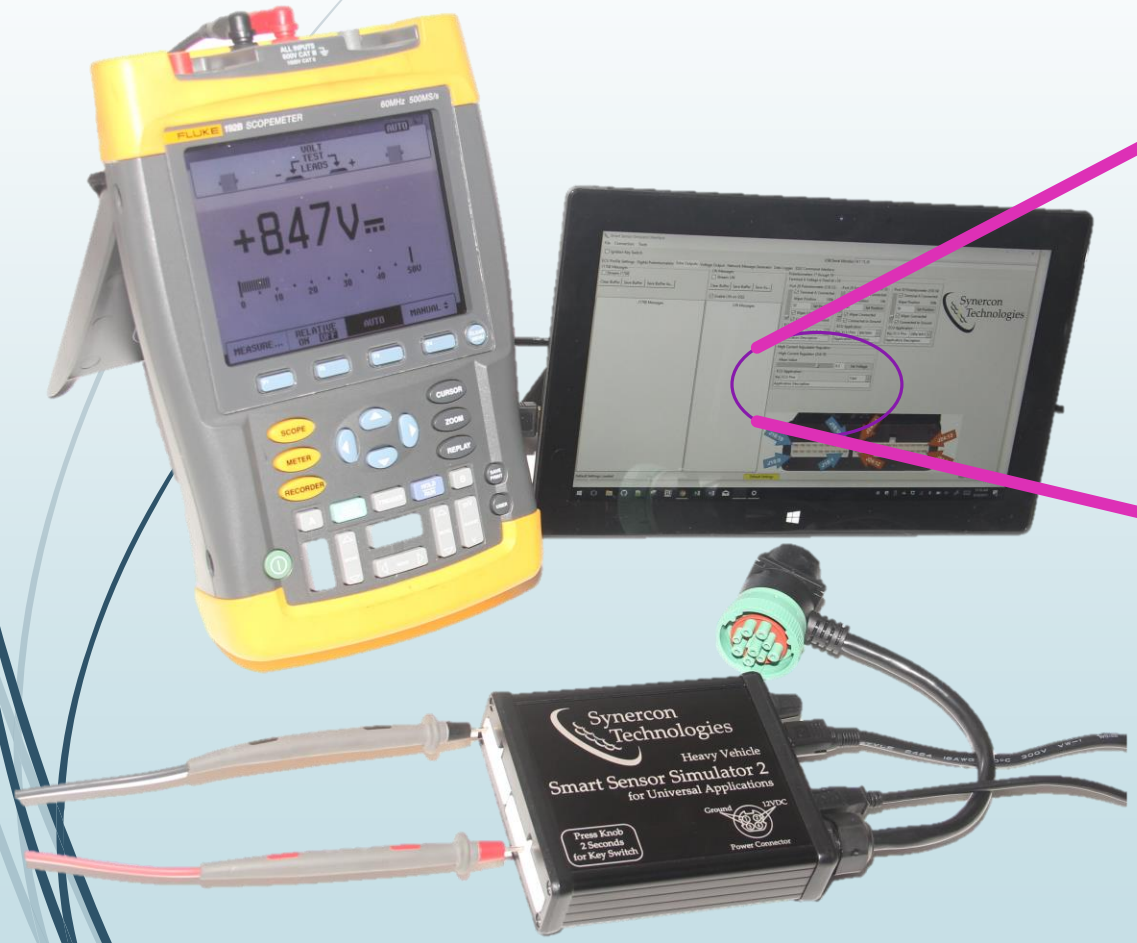
Easy Way

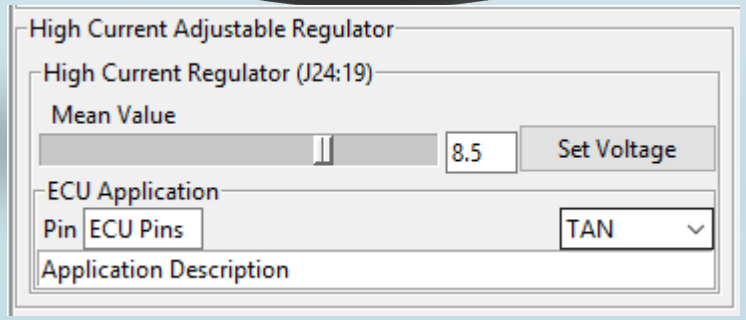
- Smart Sensor Simulator Interface Application



Example of Adjusting the SSS2

- Slide to adjust voltage

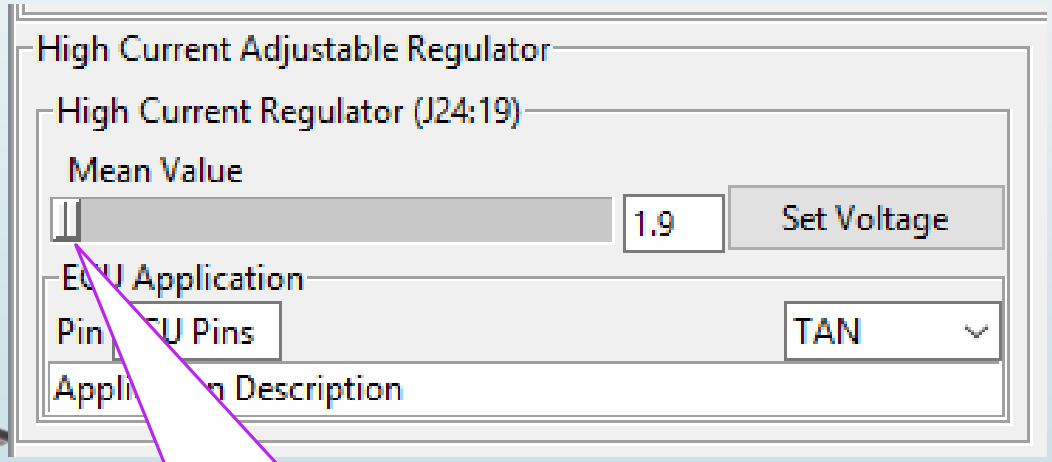




Example of Adjusting the SSS2

See the meter match the slider value.

Can also directly type voltage and press the Set Voltage button.



Move the slider to a minimum value.

Probe connected to J24:19 and Ground

Adjust Digital Potentiometer as a Voltage Divider

210/255

Potentiometers 1 though 8
Terminal A Voltage Enabled
Terminal A Voltage for U1 and U2
+12V +5V
Potentiometer 1 (J24:1)
Terminal A Connected
Wiper Position 10k
210 Set Position
Wiper Connected
Connected to Ground
ECU Application
Pin ECU Pins PPL/WHT
Application Description
Potentiometer 2 (J24:2)
Terminal A Connected
Wiper Position 10k
200 Set Position
Wiper Connected
Connected to Ground
ECU Application
Pin ECU Pins BRN/WHT
Application Description

43/255

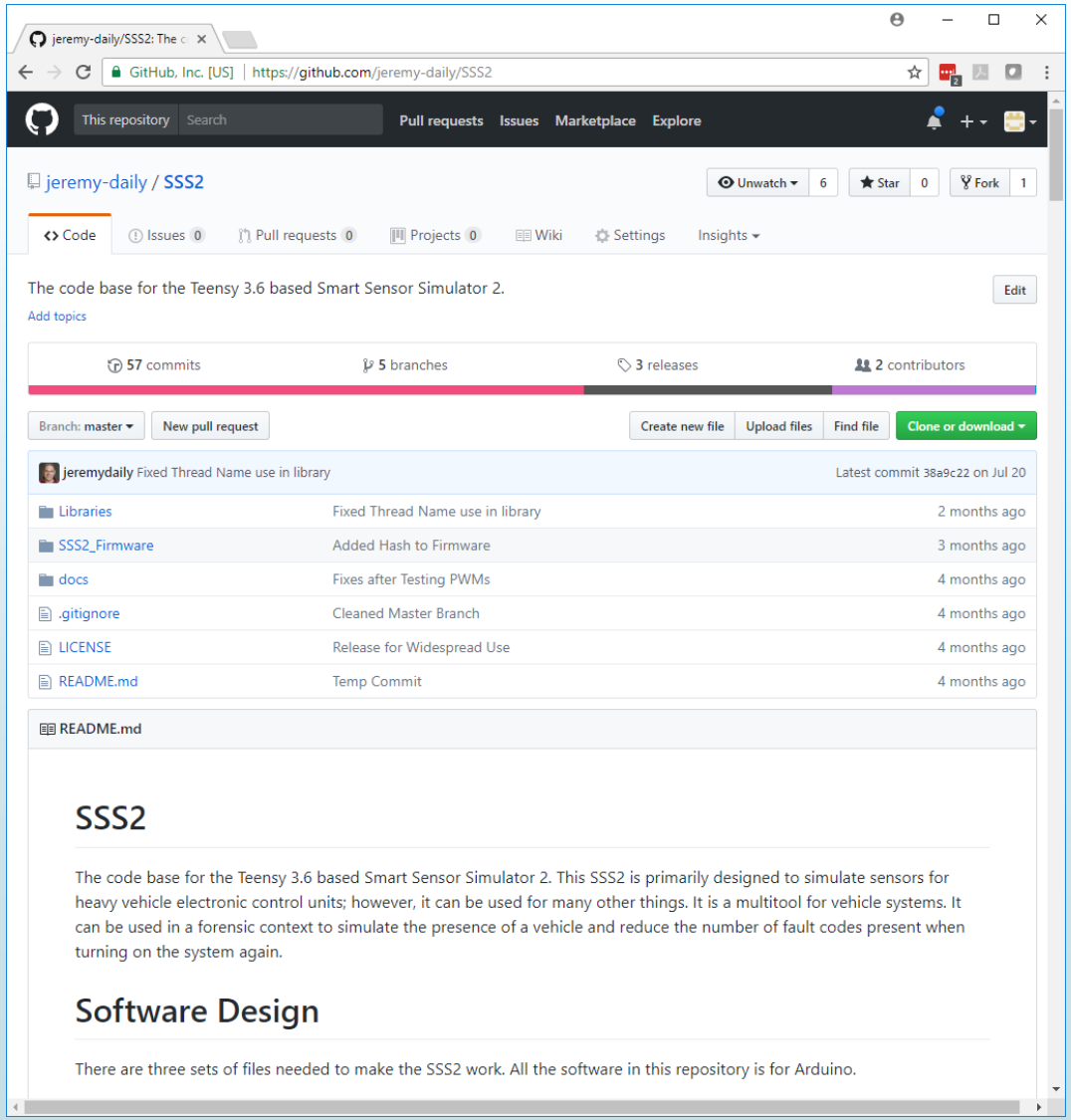
Potentiometers 1 though 8
Terminal A Voltage Enabled
Terminal A Voltage for U1 and U2
+12V +5V
Potentiometer 1 (J24:1)
Terminal A Connected
Wiper Position 10k
43 Set Position
Wiper Connected
Connected to Ground
ECU Application
Pin ECU Pins PPL/WHT
Application Description
Potentiometer 2 (J24:2)
Terminal A Connected
Wiper Position 10k
200 Set Position
Wiper Connected
Connected to Ground
ECU Application
Pin ECU Pins BRN/WHT
Application Description

Low Level Access to the SSS2

- Based on the Teensy 3.6 USB development platform from PJRC.com
- Source Code and Schematics are available on Github:

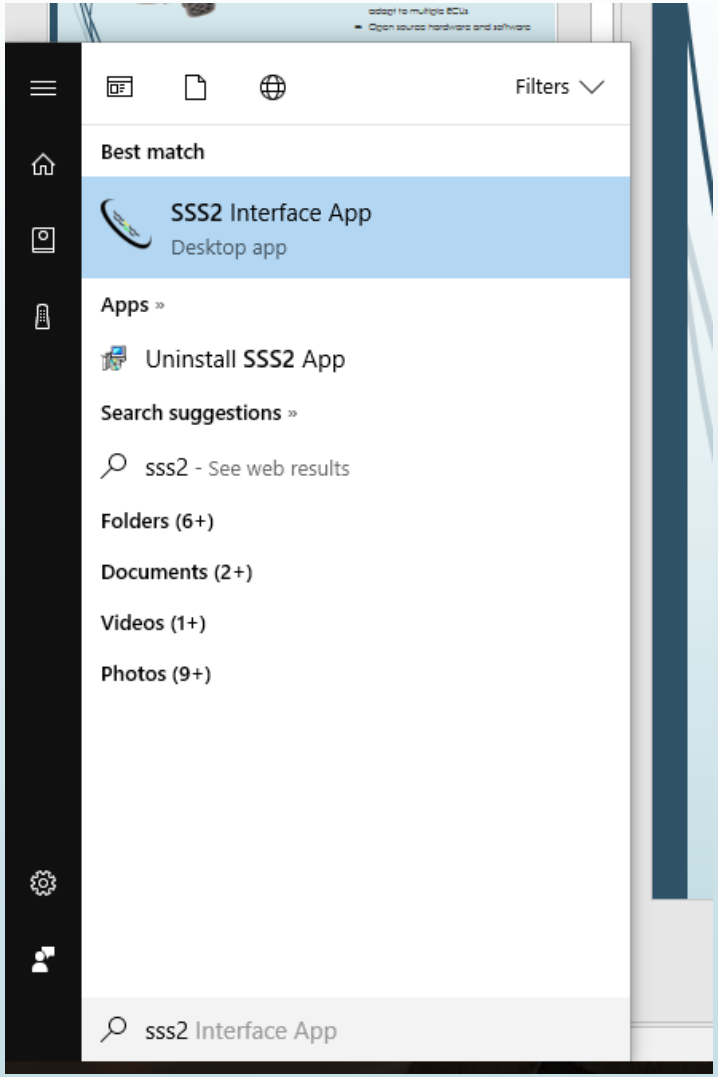
https://github.com/jeremy-daily/SSS2

- Complete listing of all the Serial commands
- Examples for CAN and sensor simulation
- Useful for building your own applications



SSS2 Interface Application

- Download from http://synercontechnologies.com/sss2/
- Controls the adjustable analog signal generation in the SSS2
  - Analog Voltage Output for Pressure Sensors
  - Pulse Width Modulated Output - Tone ring generation and Accelerator Pedals
  - Digital Potentiometers – Temperature sensors, Accelerator Pedals
- Low Level CAN/J1939 message generation
  - Simulate network traffic from other ECUs
  - Create multi-packet bursts
  - Send individual CAN frames
- CAN Frame Data Logger
  - Sorts by ID
  - Exports to CSV file



Step 1: Download the SSS2 Interface Application

Synercon Technologies

synercontechnologies.com/sss2/

FLA Portal

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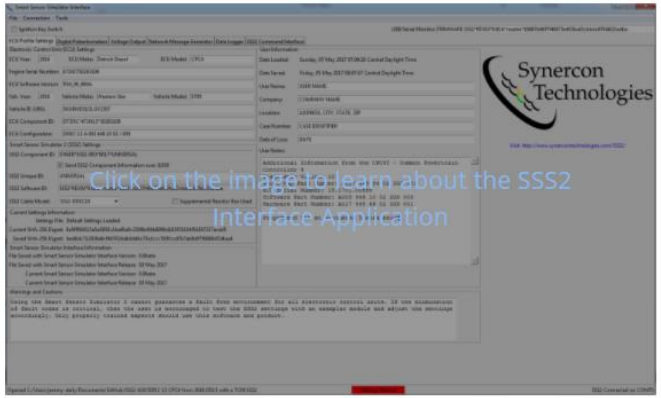
Smart Sensor Simulator 2

The Smart Sensor Simulator 2 is a small package to simulate a big truck. The SSS2 creates an electrically equivalent system to emulate the sensors, actuators, power and communications found on an actual vehicle. You can use any RP1210 device to connect to the SSS2 through its built-in 9-pin connector. You can also use the Forensic Link Adapter to perform a benchtop download with the SSS2.

Smart Sensor Simulator Interface

A Graphical User Interface (GUI) to set configurations for the SSS2 to accommodate different ECUs for the entire fleet. This enables you to have just one Smart Sensor Simulator 2 for all your electronic control unit interface needs.



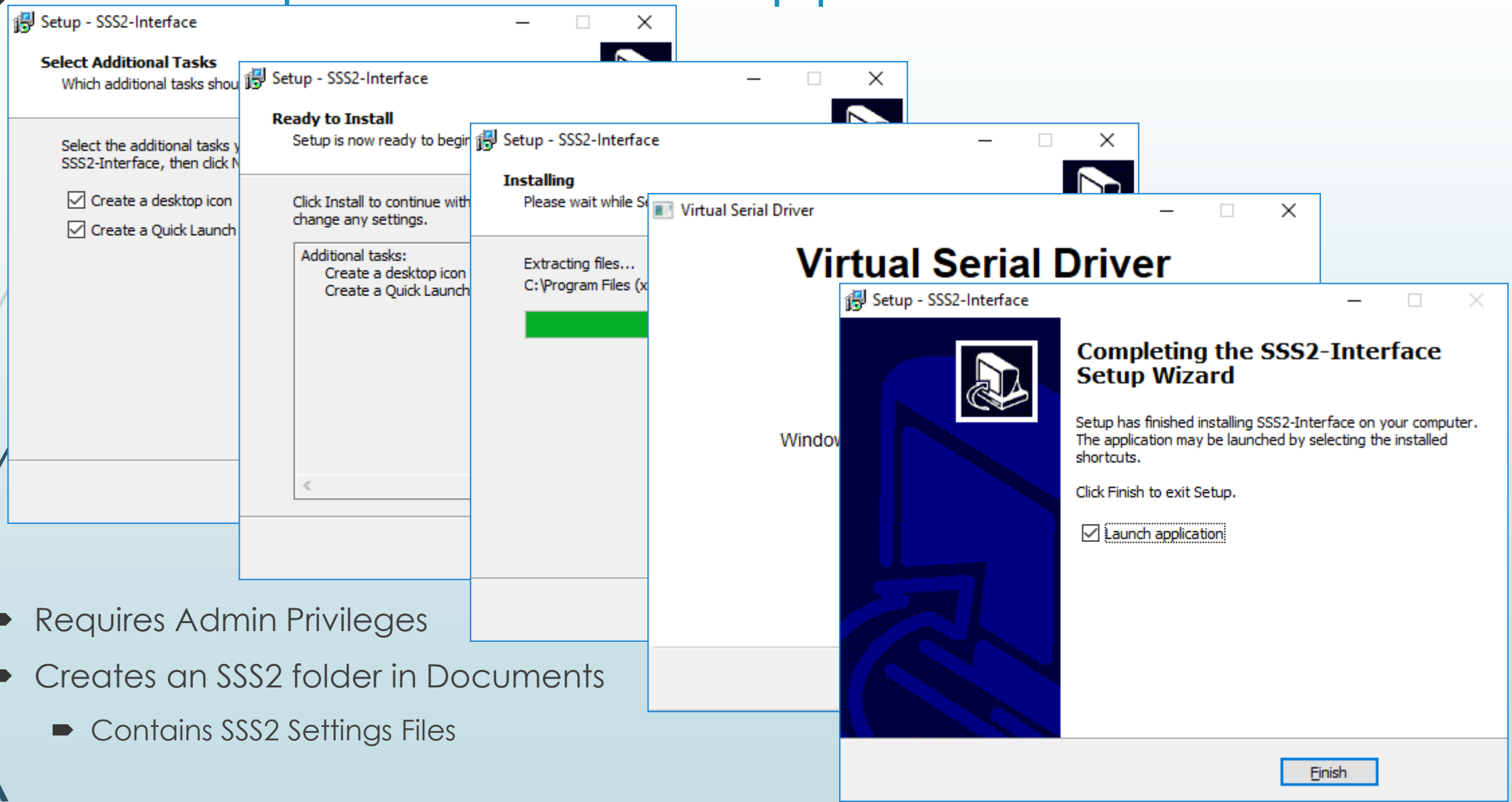
Current Release:

SetupSSS2Interface-1.0.7.exe

SetupSSS2Interface-1.0.7.zip (Try this in case your computer restricts downloading executable files.)

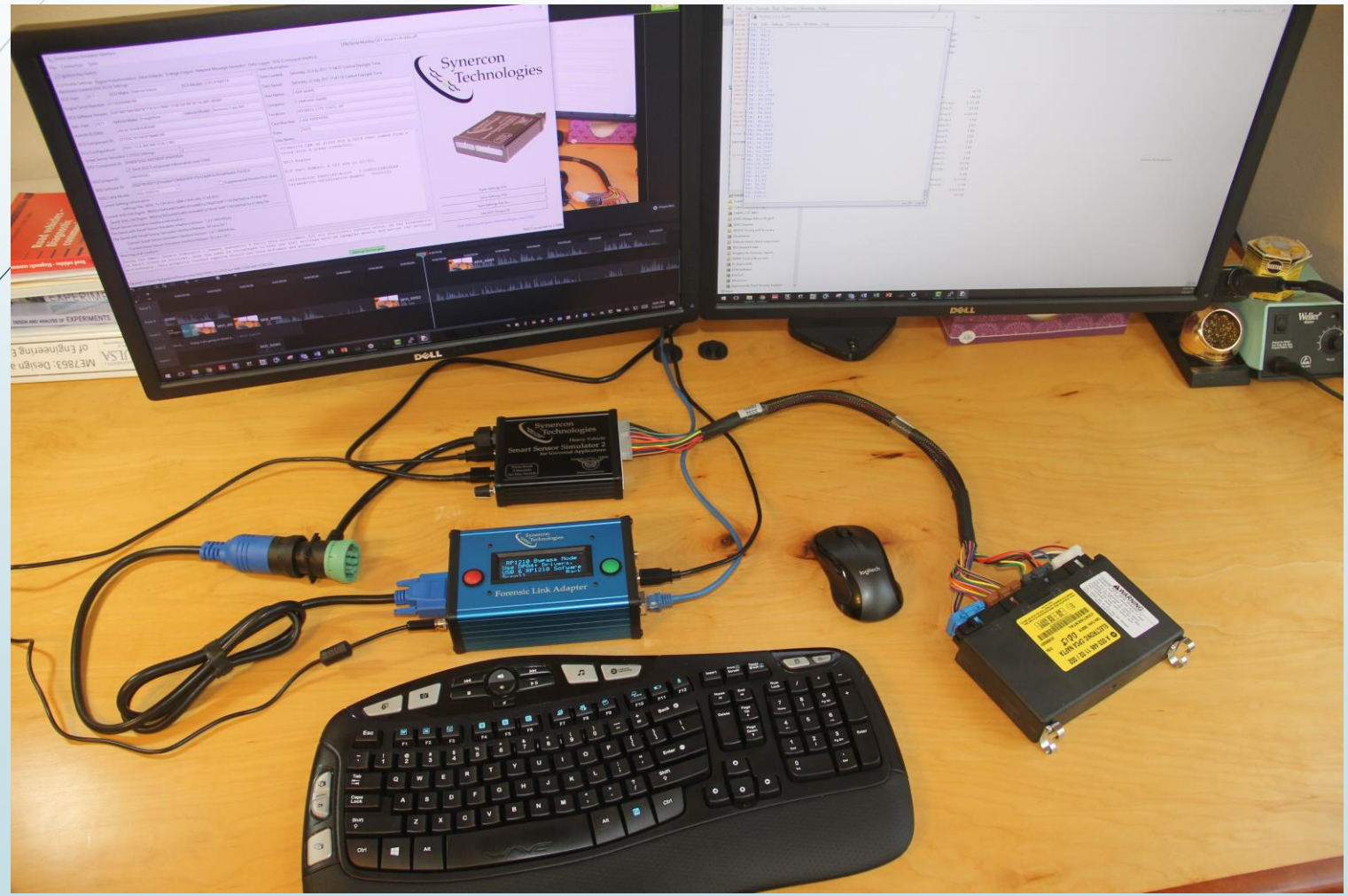
This installer includes a serial driver to communicate with SSS2 from Windows 7 and 8. Windows 10 should already have the driver installed.

Step 2: Install the Application



- Requires Admin Privileges
- Creates an SSS2 folder in Documents
  - Contains SSS2 Settings Files

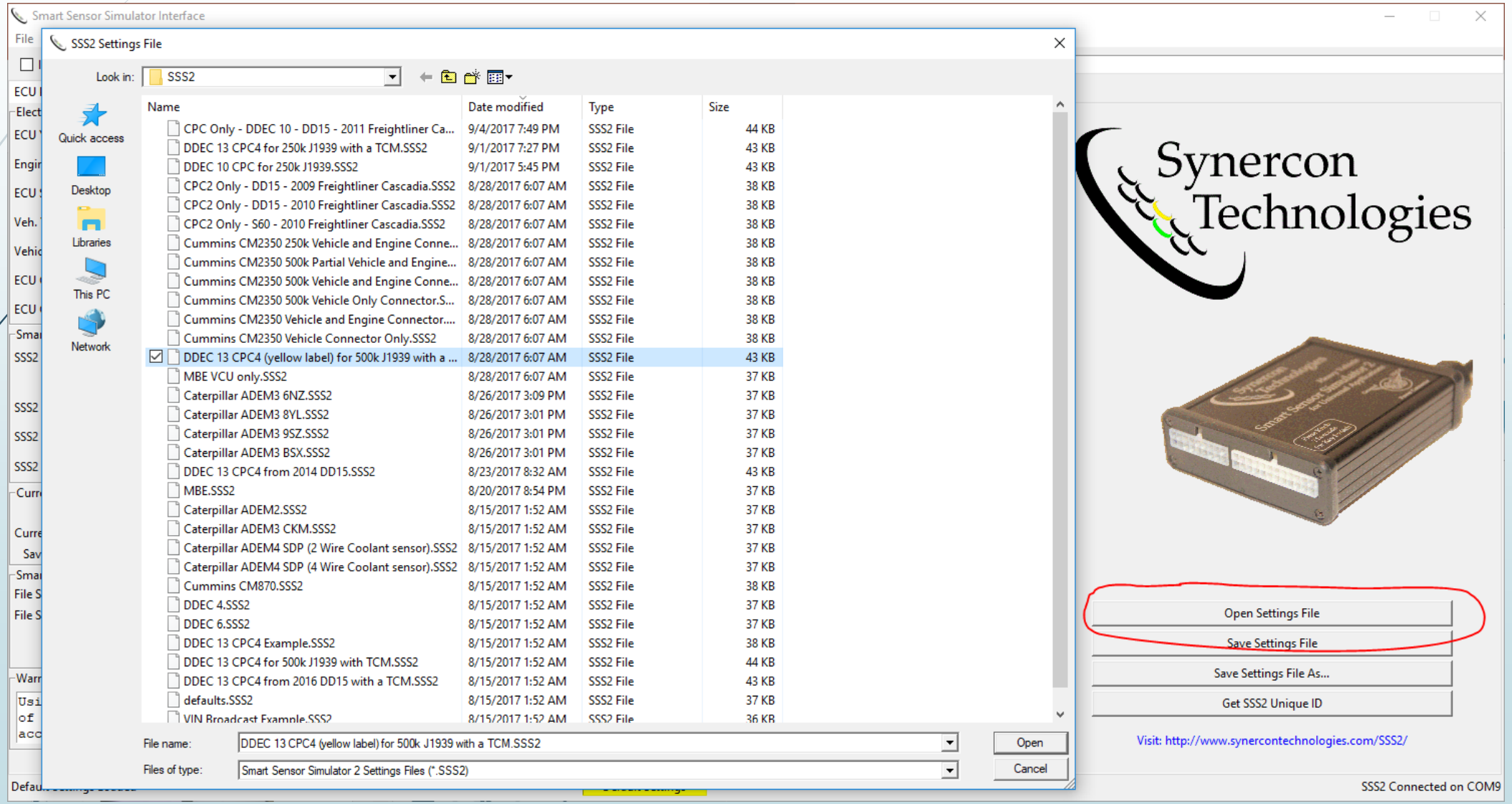
Step 3: Connect Power, USB, VDA and an Exemplar ECU



Don't turn on the key switch yet.

VDA = Vehicle Diagnostic Adapter (like the FLA or Nexiq)

Step 4: Load the SSS2 Setting File

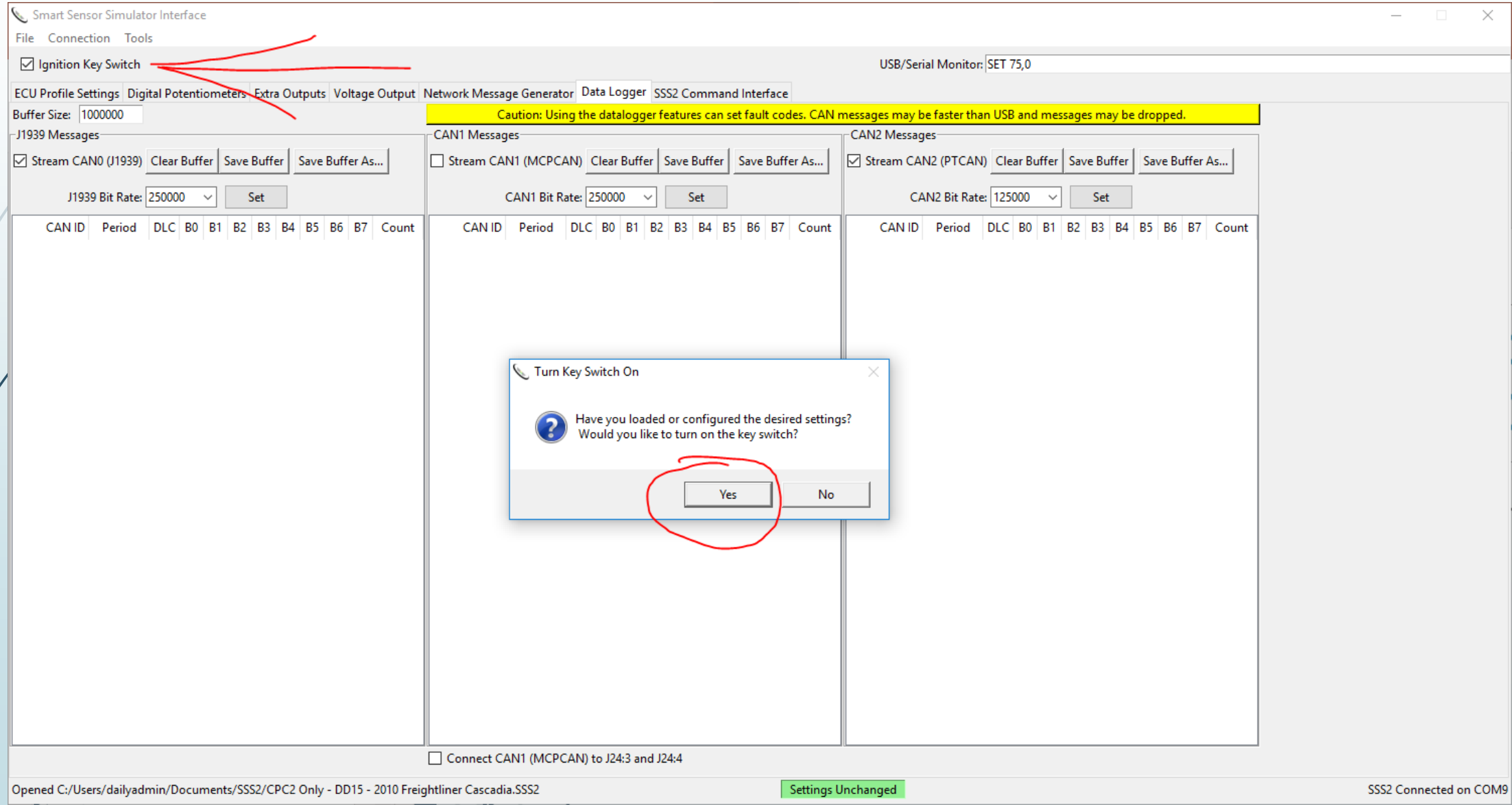


Step 5: Confirm Settings (Forensic Use)

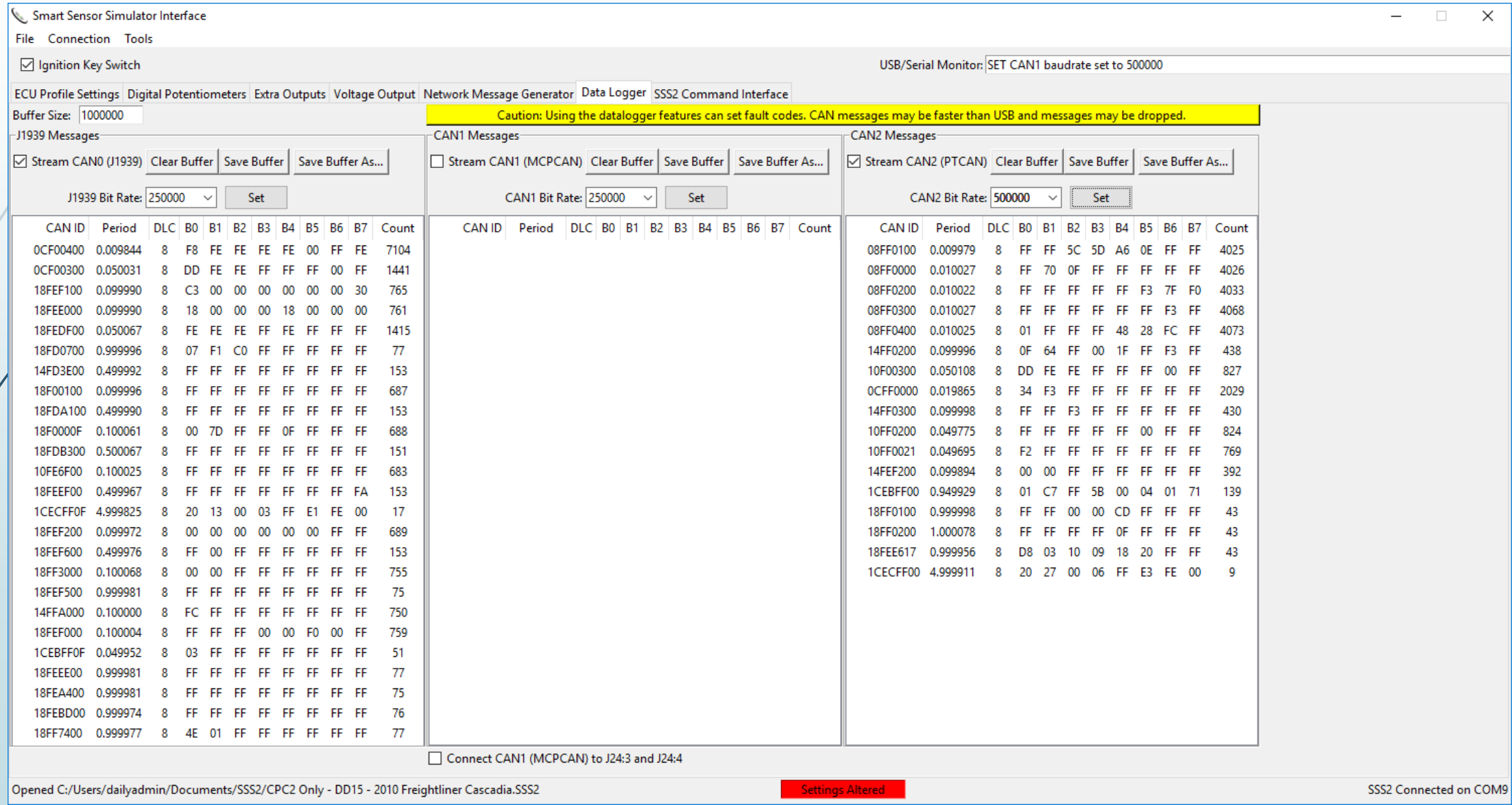
- If performing a Forensic Investigation connect an Exemplar ECU with the same programming as the Subject ECU.
- Turn on the key switch and verify operation.
  - Adjust settings if necessary
  - Add CAN messages if needed
- Turn key switch off, wait until the messages turn off
- Unplug the exemplar module, but not the SSS2 (this keeps the settings loaded)
- Plug in the Subject ECU (Settings will hold from the previous session)
- Turn on the Key Switch and perform the download.

Note: Failure to do this step may result in undesired Fault Codes being set on the Subject ECU

Step 6: Turn the Key Switch On



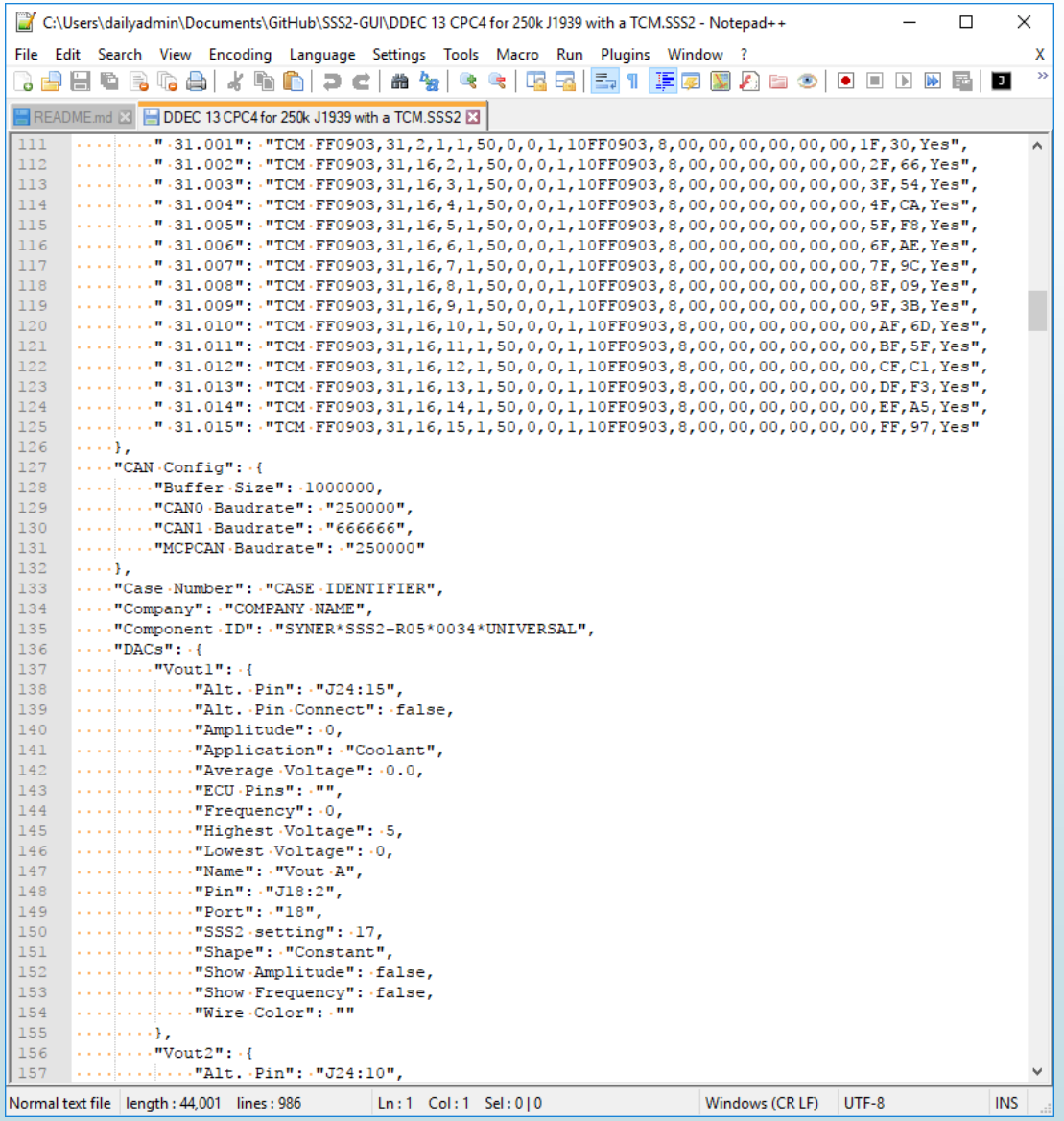
CAN Data Logger – Check Connection



Step 7: Download Data

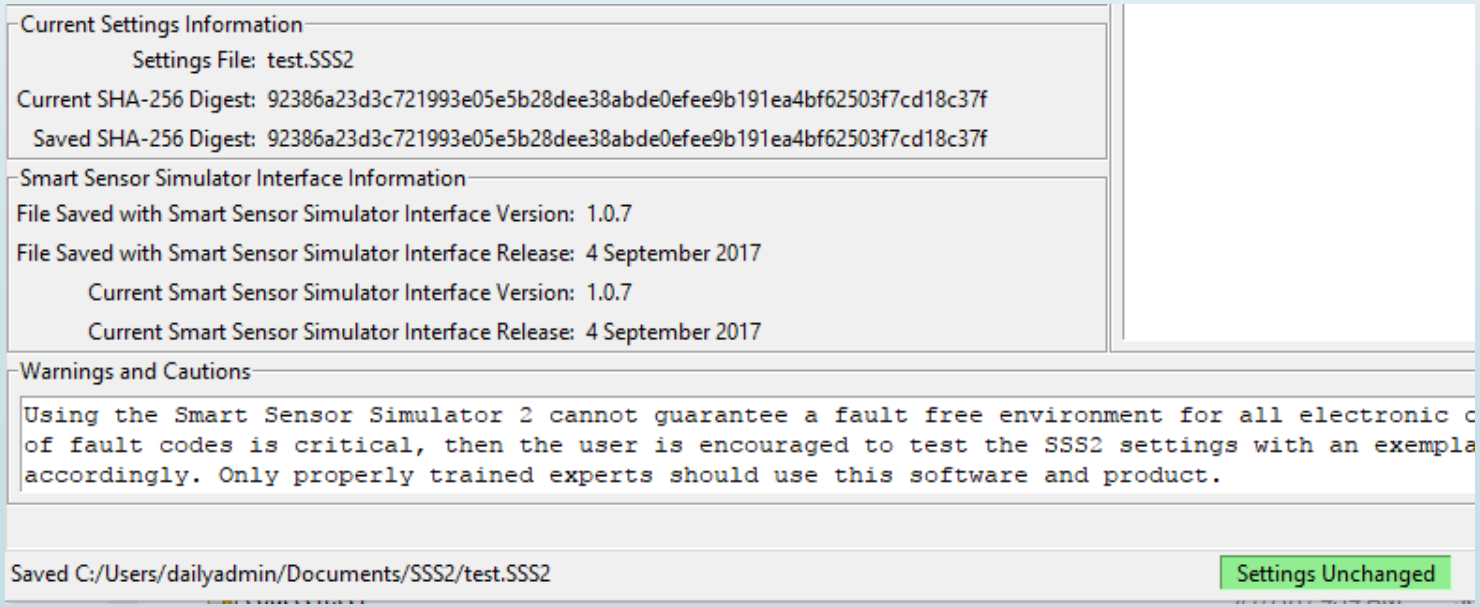
What is an SSS2 Settings File?

- A JSON text file to store settings data used for a particular session.
- Uses a SHA-256 check to ensure file has not been altered outside the SSS2 Interface App.
- Stores all the adjustable parameters (including CAN).
- Can store case file information.
- Open and view with a text editor.
- Synercon Technologies provides example .SSS2 files.
- Users should generate their own files for each case.



Saving Files

- The SSS2 Interface App can save settings files
  - SSS2 should be connected.
  - The correct Unique ID is needed.
- File keeps track of dates and times automatically.
- Status bar shows file location.
- Current settings are checked against the saved settings with a Secure Hash Algorithm (SHA).
  - Green Box = settings match the file
  - Red Box = Settings have changed

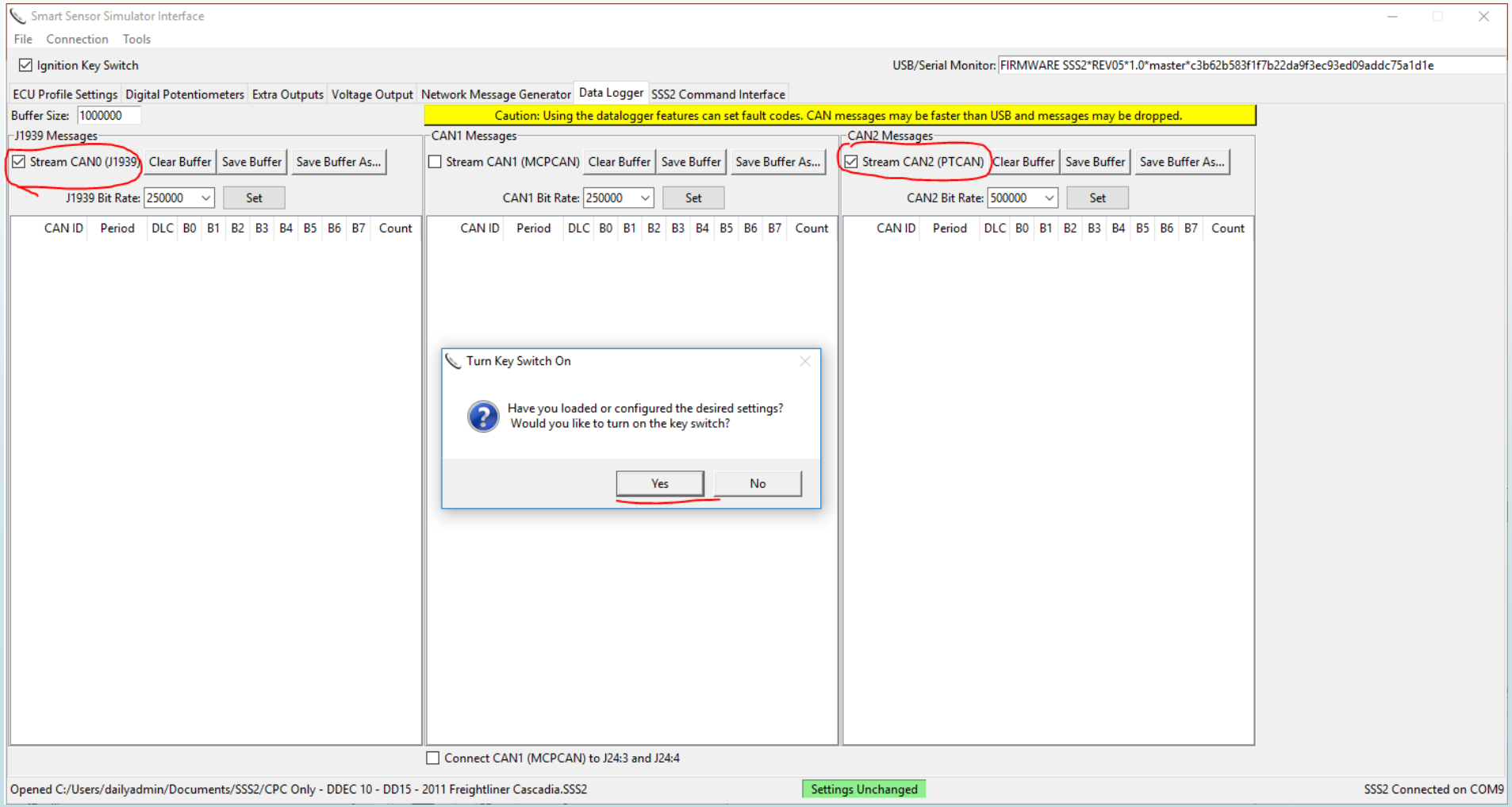


Opening Files

- Files open quickly, but load onto the SSS2 slowly.
- Press CTRL-O, Press the Open Settings File button or Select the File Menu and Open.
- Most Synercon Technologies provided files will have ECU data that was used for the test.
  - Engine Serial Number
  - Year, Make, Model
  - Other notes
- Files are saved per ECU and are not general across all ECUs in that family.
  - Exemplar Module testing is important to make sure the Synercon template file will work.
  - ECUs with similar outward appearance can have different software or internal circuits.

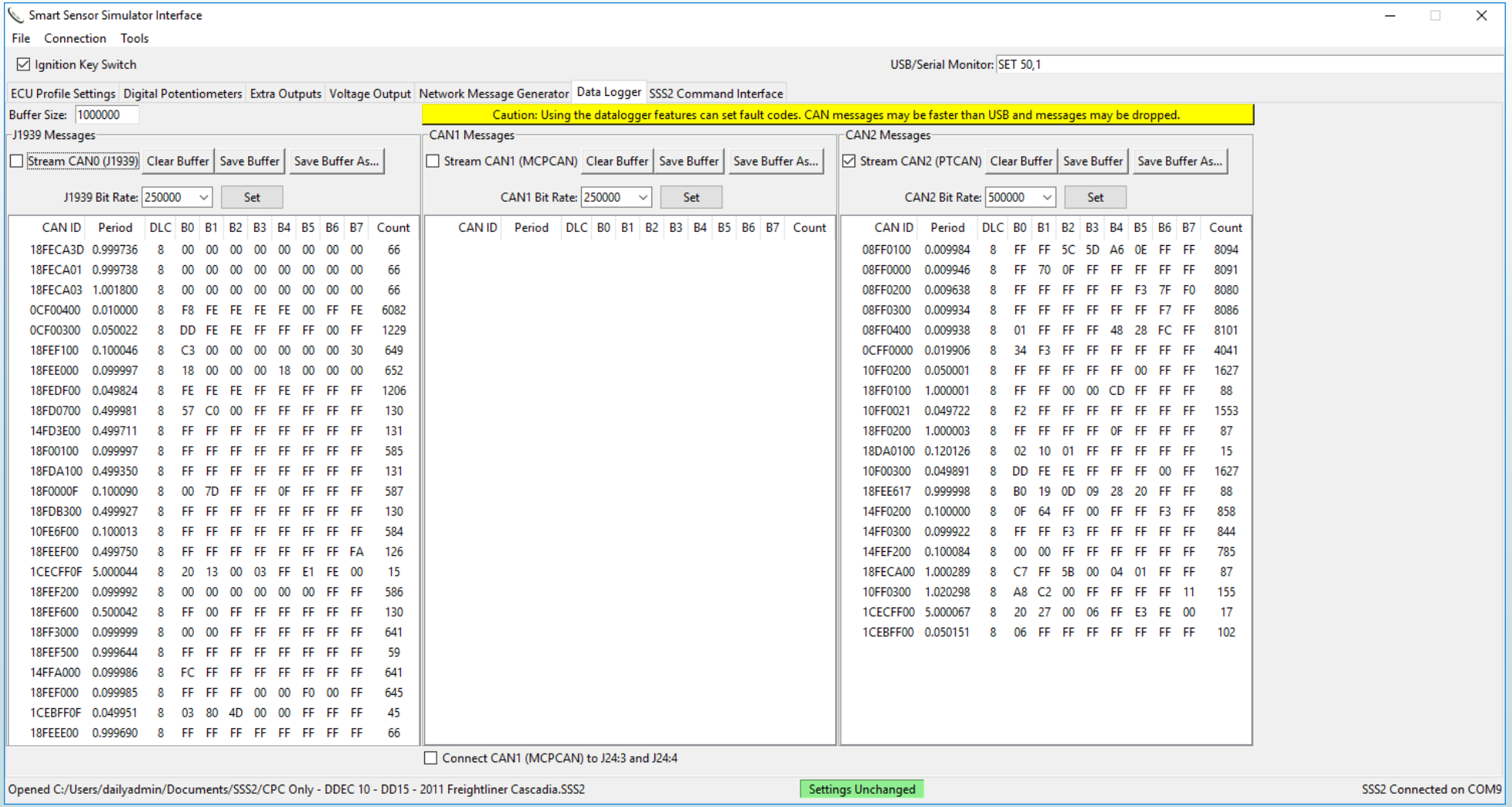
CAN Message Logging

- Example of a CPC from a DDEC 10 with 500k CAN on the PT-CAN



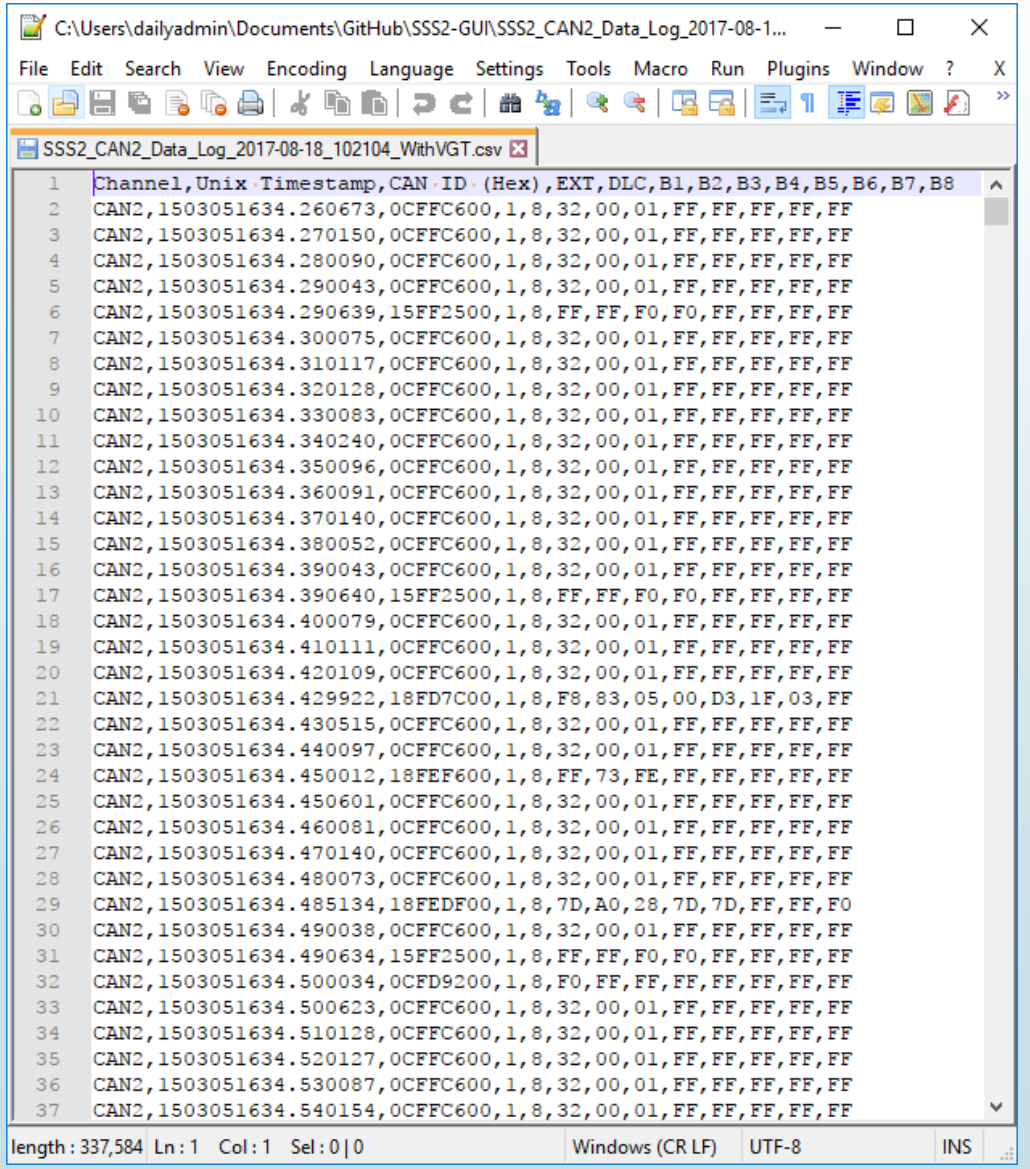
CPC from DDEC 10 CAN Traffic

- The SSS2 logger only captures external traffic (not what it produces).



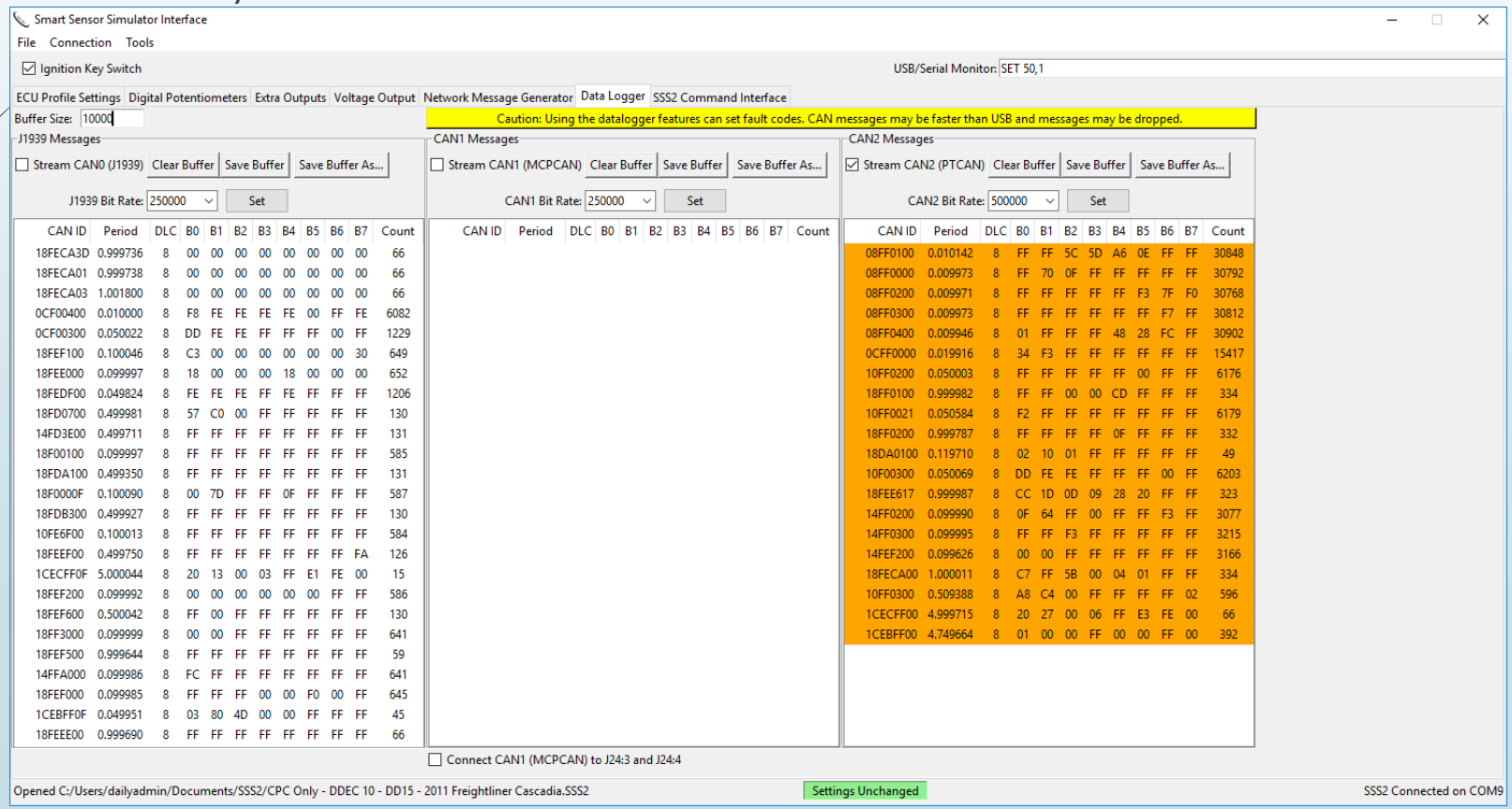
CAN Data Logger

- CAN data is streamed over USB in binary form.
- SSS2 Interface App decodes the binary and stores it in a list.
- Display tables are based on ID
  - If a new CAN ID is found, it is entered into the display table
  - Messages with existing CAN IDs add an increment to the ID counter
  - ID rates are calculated.
- Saving the Buffer creates a CSV file and clears the list of messages.
- CSV file can be opened in Excel.
  - Use Text Import Wizard
  - Import columns as Text, not General
- CAN data is in Hexadecimal
- Timestamps are in seconds from Jan. 1, 1970



CAN Message Logger Buffer Size

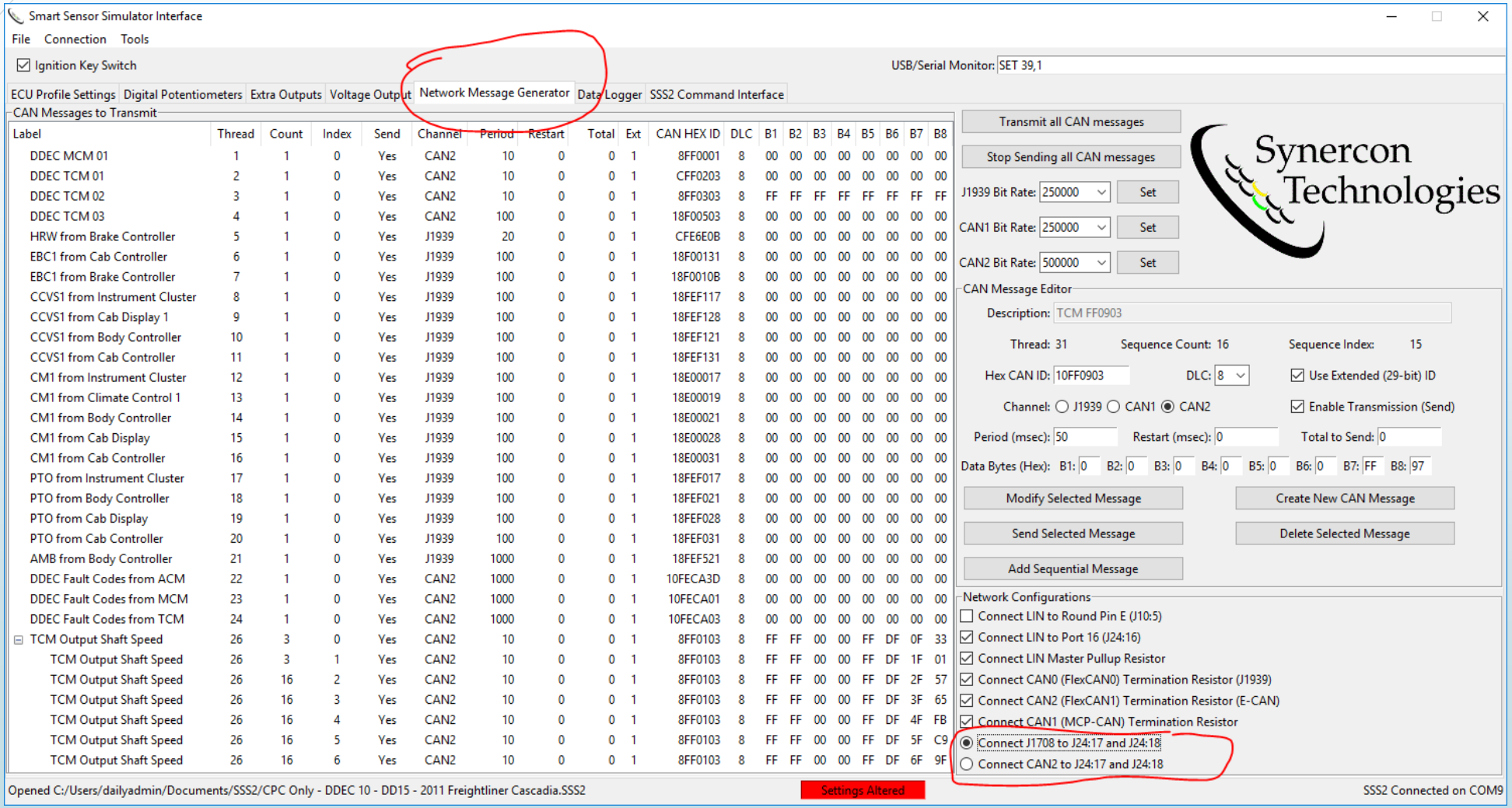
- If the number of CAN messages in memory exceeds the buffer space, logging will cease and the streaming data will be highlighted.
- The message lists take up memory, so they have to be constrained based on system resources.



Clearing or Saving the Buffer will enable continued logging.

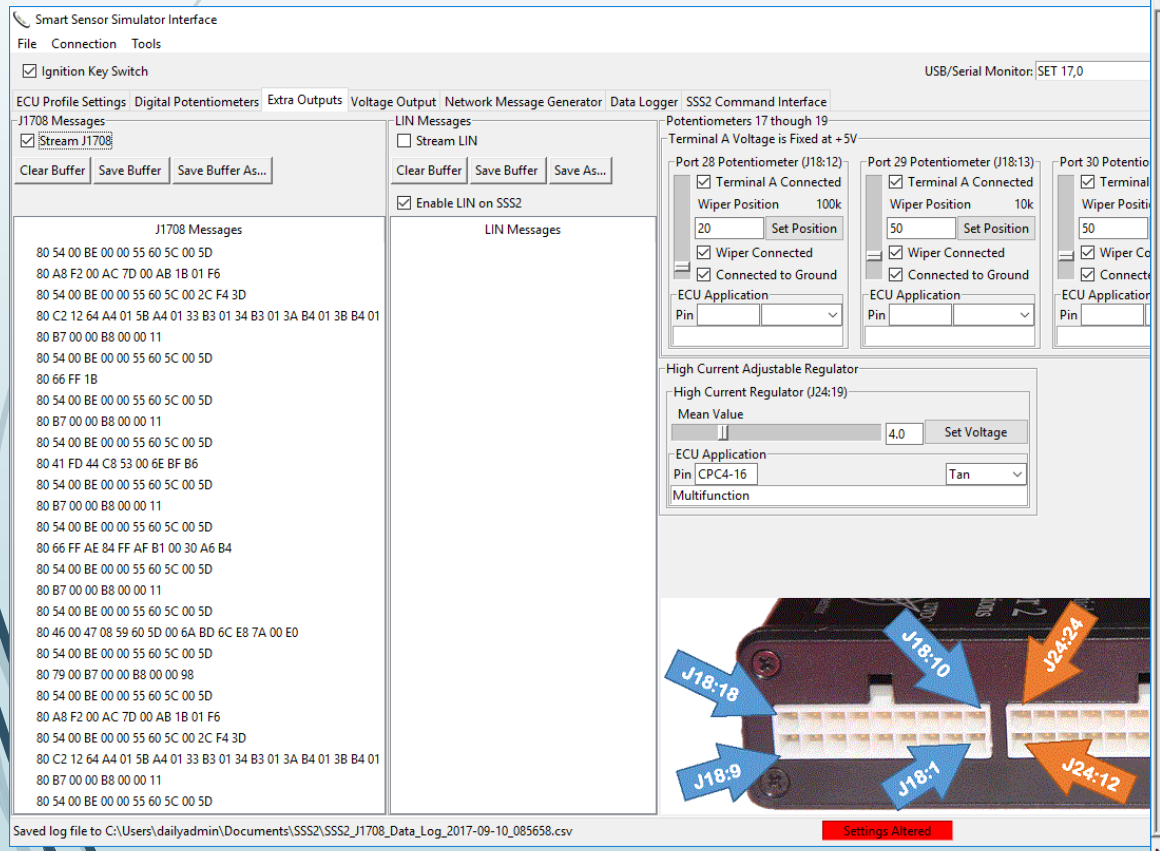
J1708 Message Logger

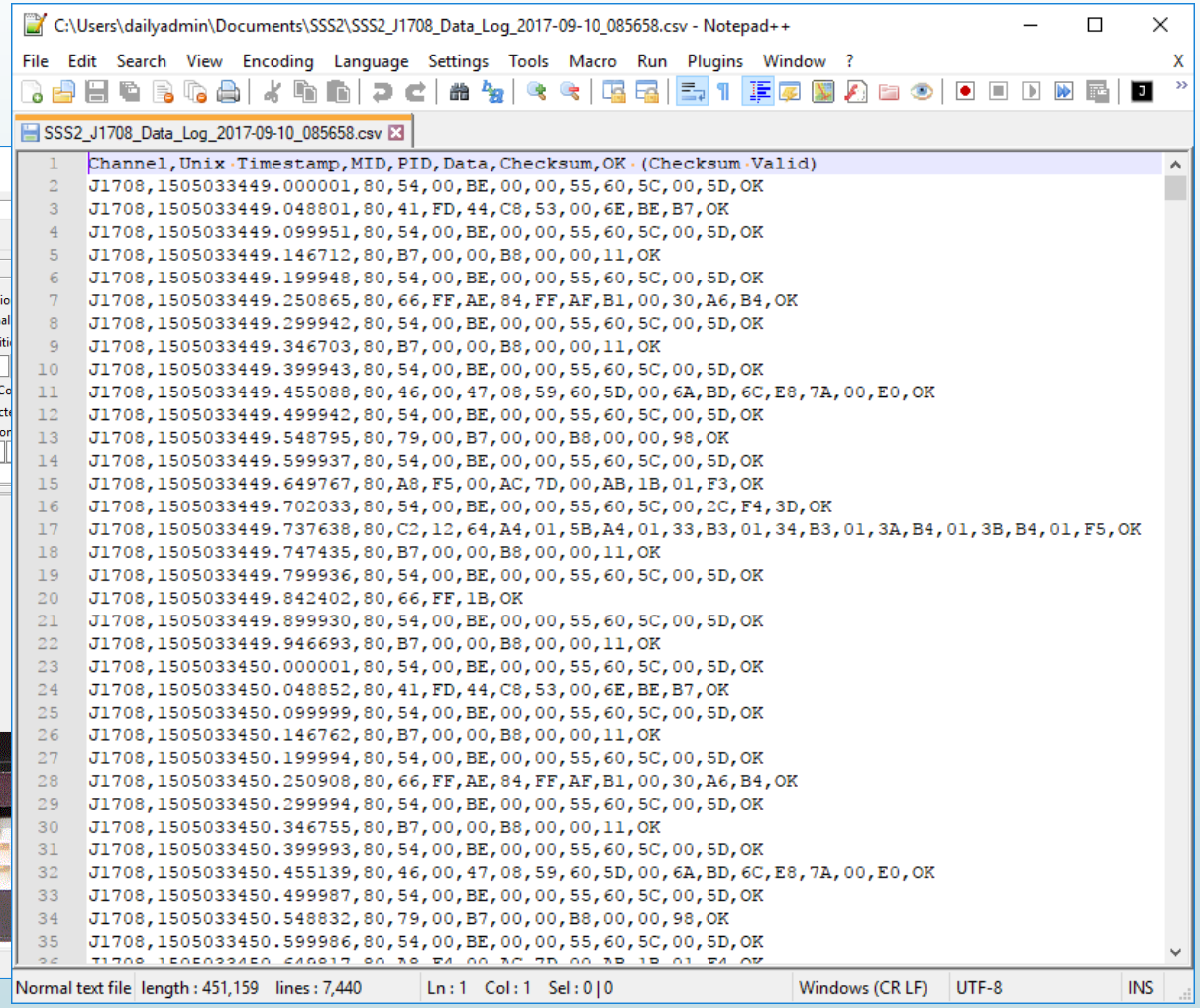
- Connect J1708 to the external pins from the Network Message Generator tab.



J1708 Logger

- J1708 Messages are passed with a checksum
- The buffer contains a timestamp
- All data is in hex

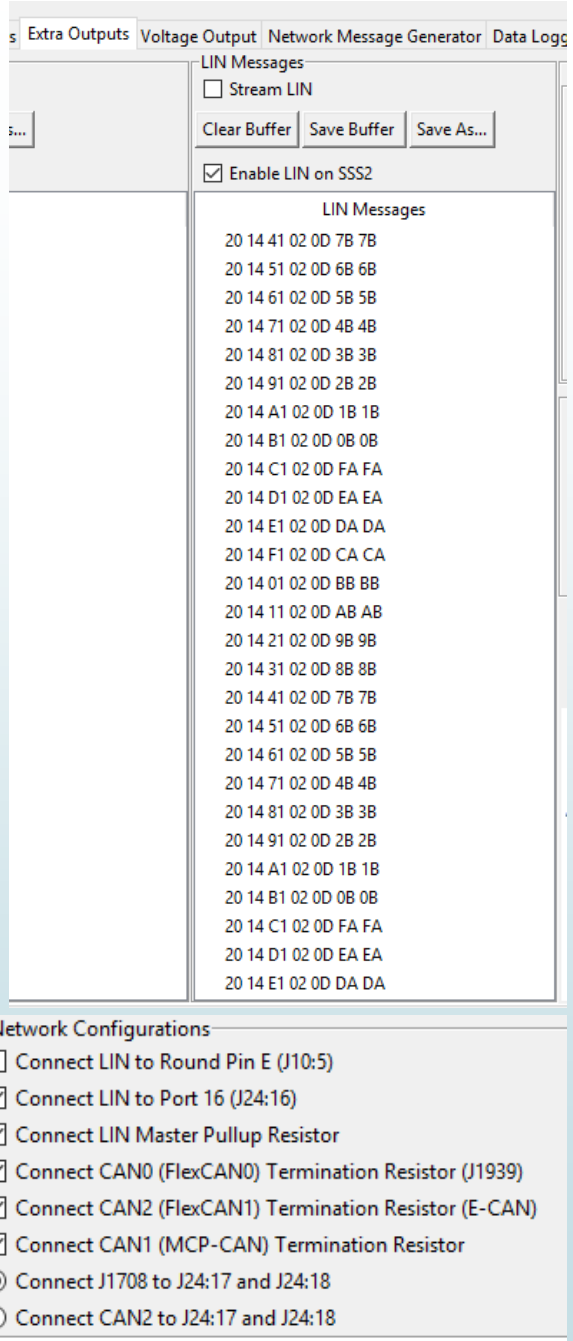




Local Interconnect Network (LIN)

- The LIN messages for a DDEC 13 with a shifter are hard-coded into the SSS2.
- SSS2 acts as a LIN Slave node.

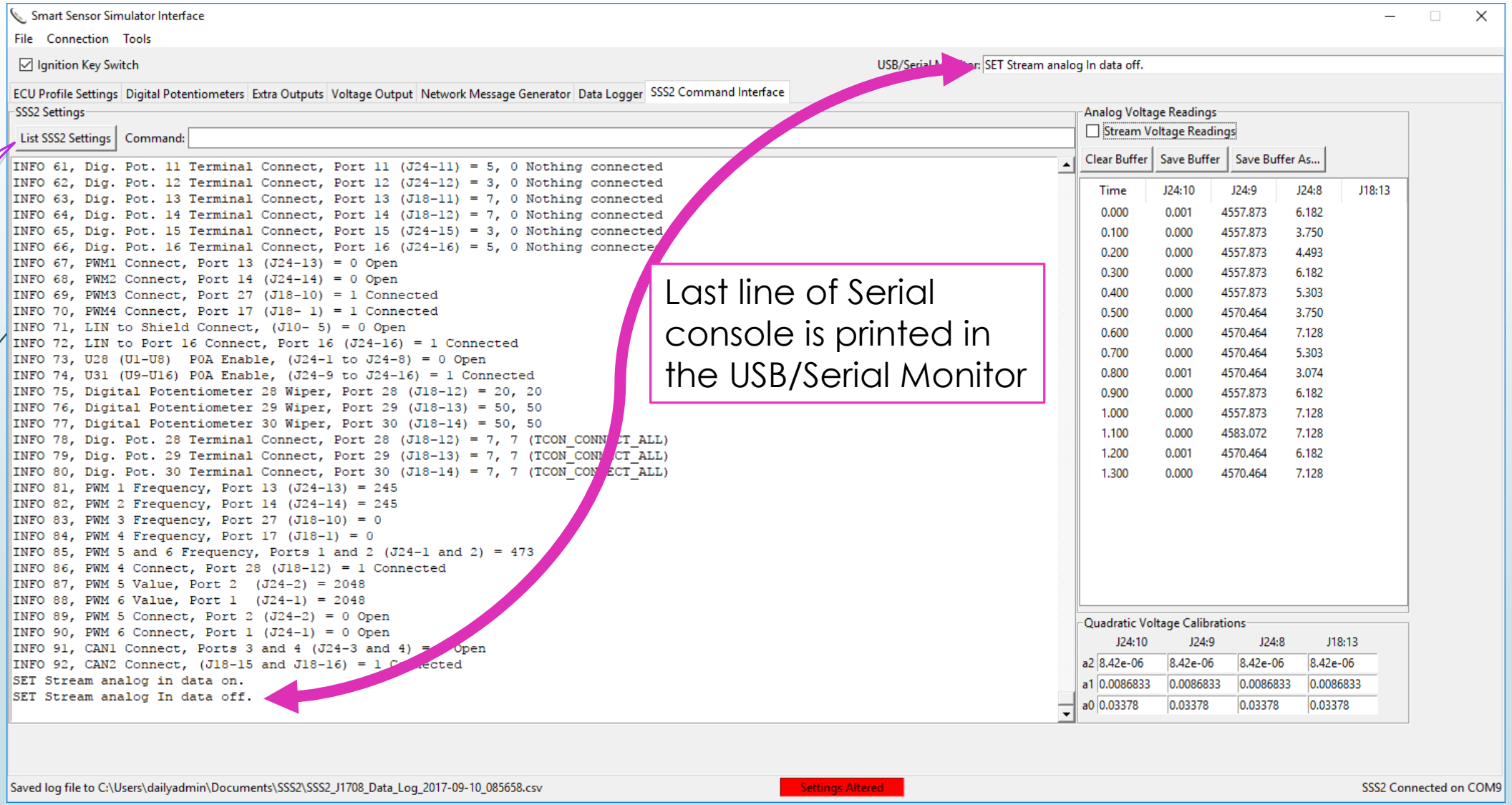
Image of Detroit Diesel Self-Shift Lever
http://www.truckinginfo.com/fc_images/articles/m-img-0029.jpg



SSS2 Serial Command Interface

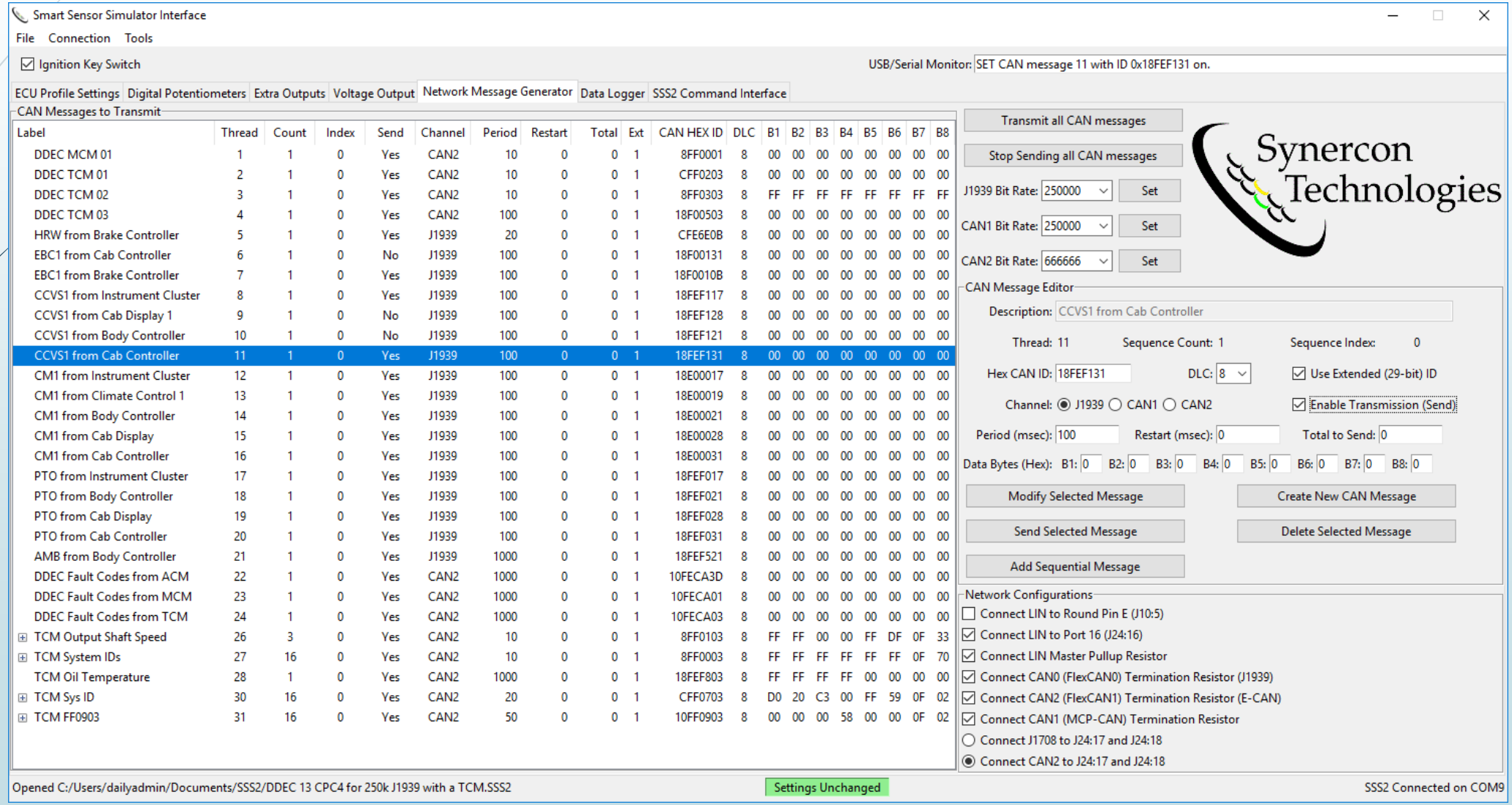
Get listing of current numbered settings

Last line of Serial console is printed in the USB/Serial Monitor



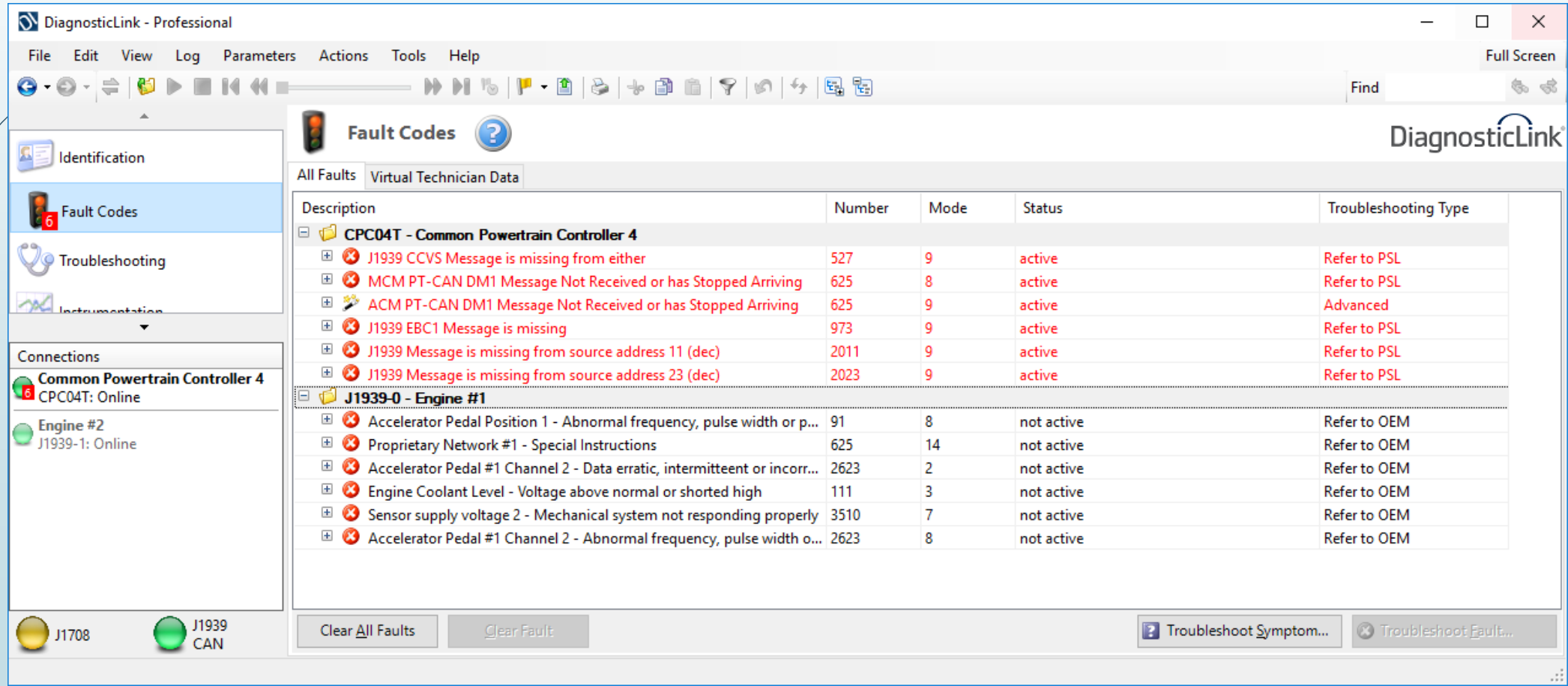
Generating CAN Messages

- A strength of the SSS2 is the ability to send periodic CAN messages



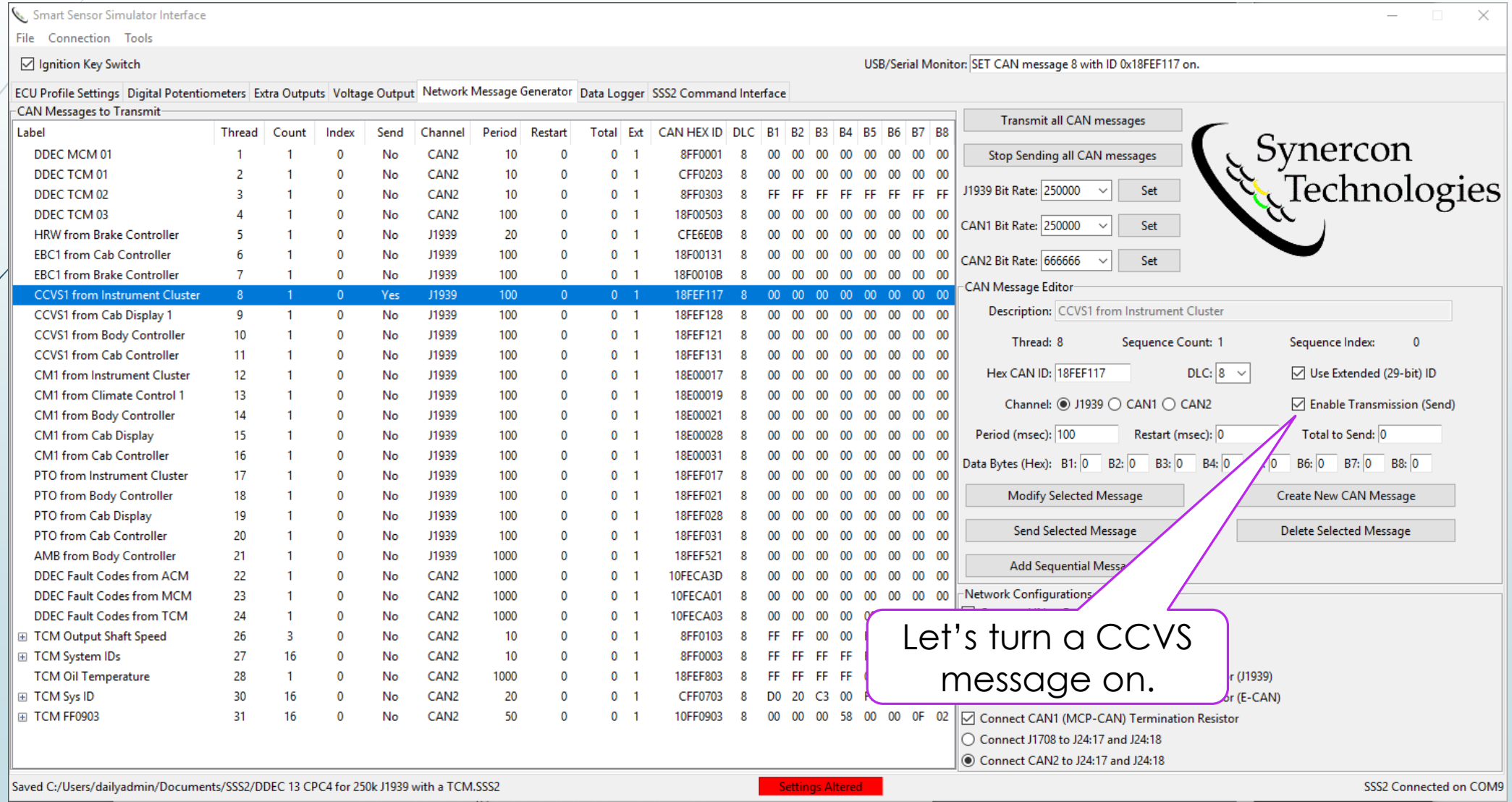
Network Message Generator Example

- Without CAN message generation, we get fault codes as seen in DDDL 8.
- Hardware configuration has a Detroit Diesel CPC4 connected to the SSS2.
- All SSS2 messages are set to not send at the beginning of this example.

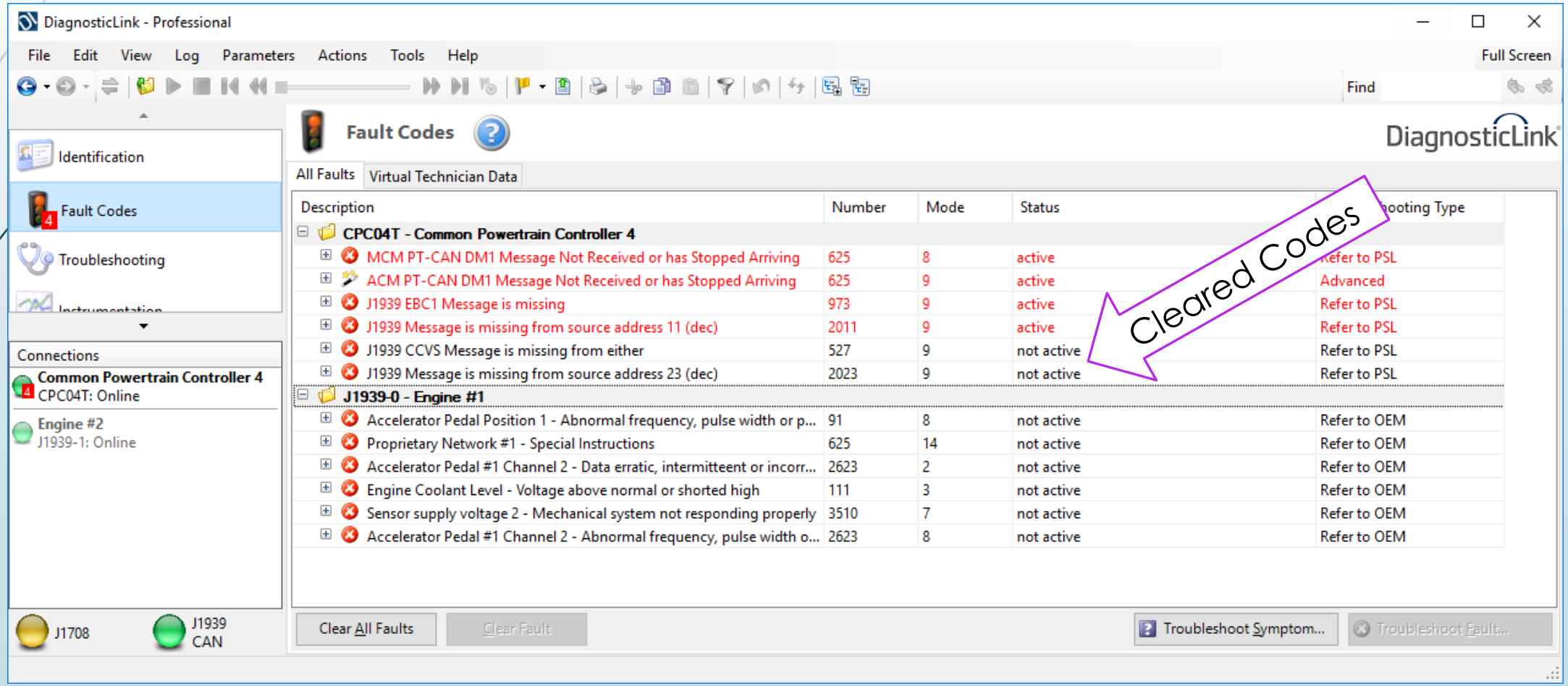


Cruise Control Vehicle Speed Message

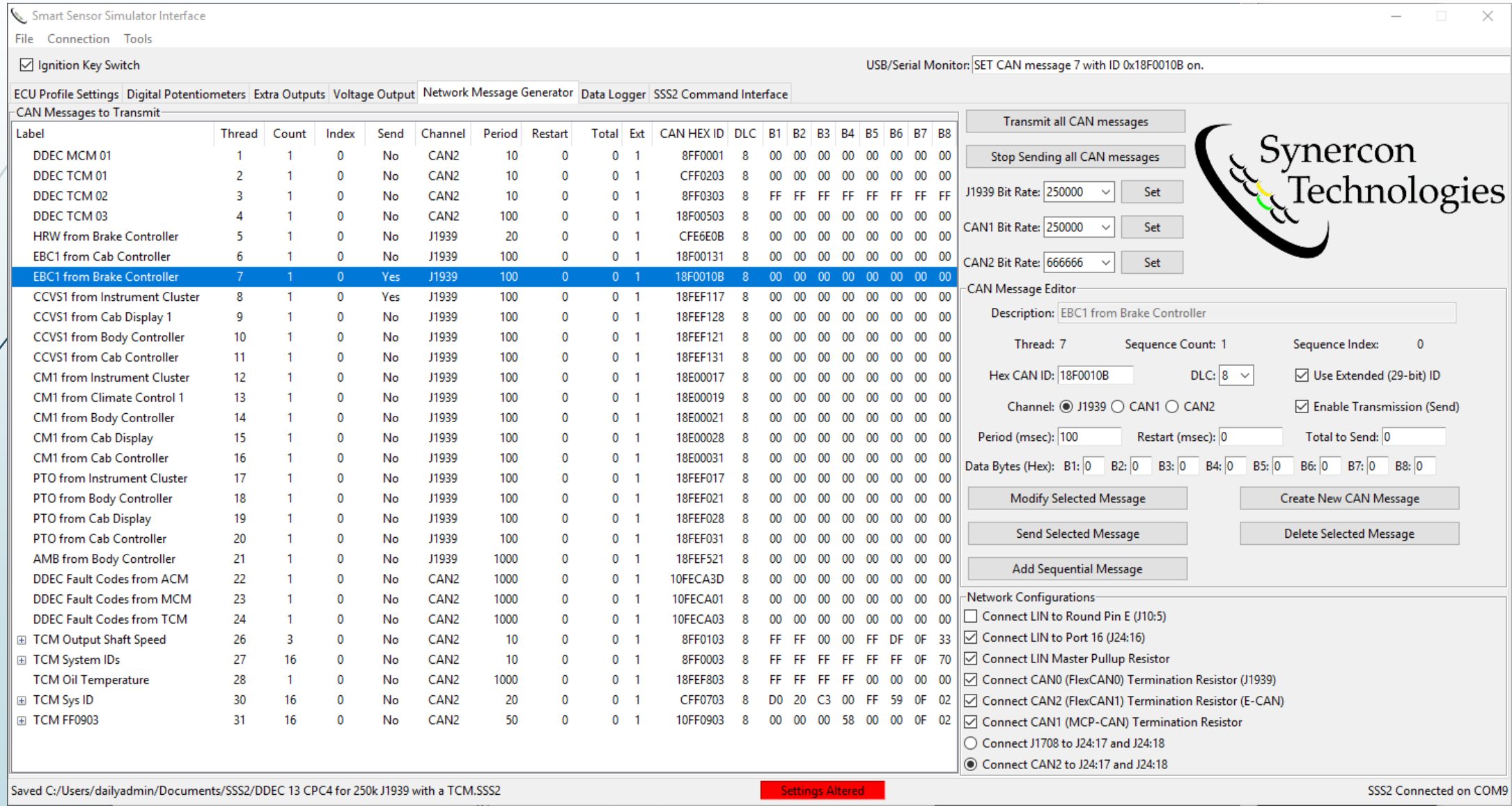
- Based on SAE J1939, Hex ID is 18FEF1XX where XX is the source address.



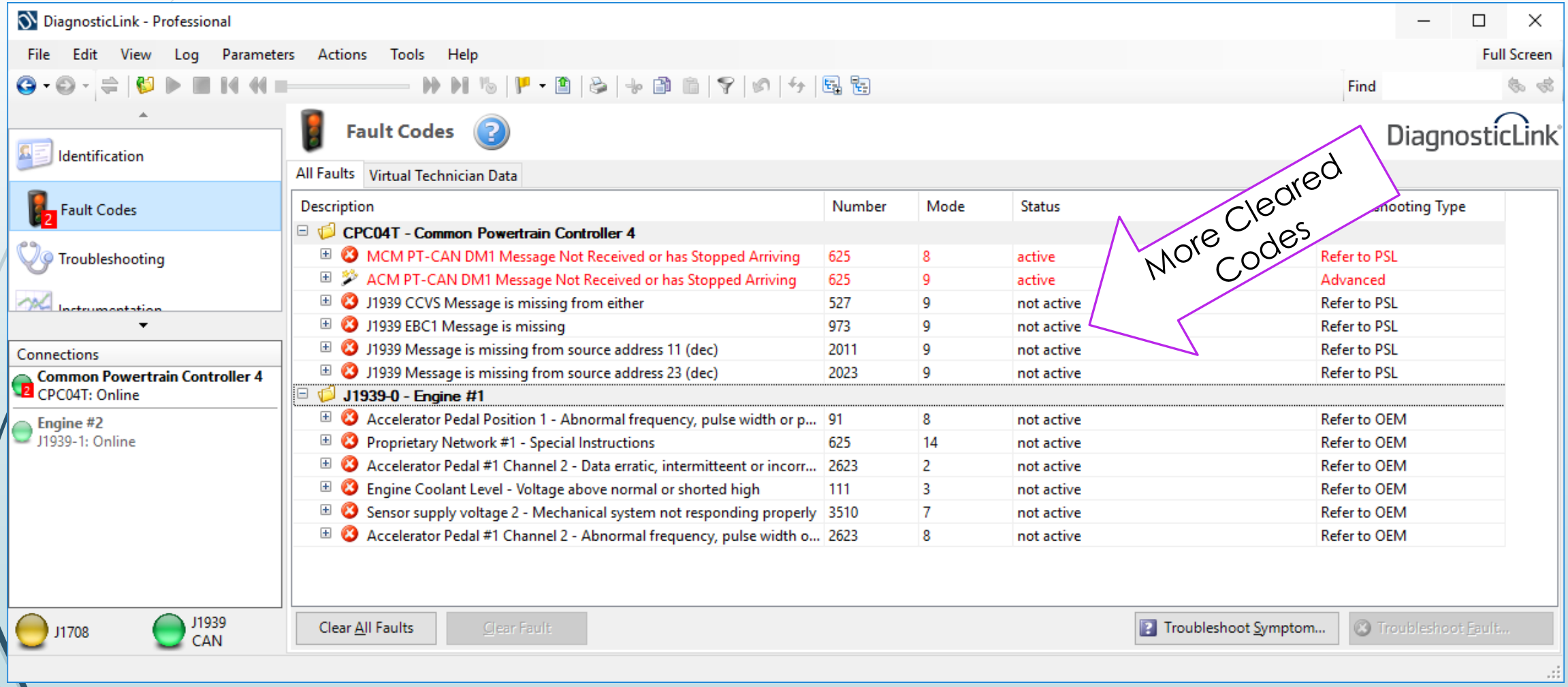
Eliminate Two Fault Codes!



Electronic Brake Controller Message



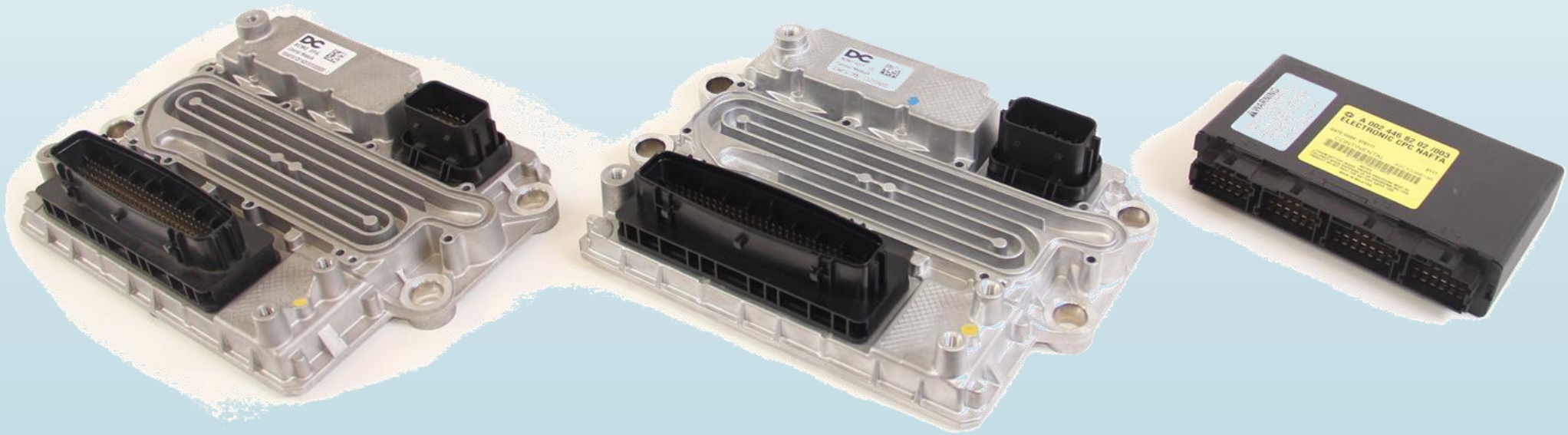
Two More Codes Cleared



Description	Number	Mode	Status	Troubleshooting Type
CPC04T - Common Powertrain Controller 4				
MCM PT-CAN DM1 Message Not Received or has Stopped Arriving	625	8	active	Refer to PSL
ACM PT-CAN DM1 Message Not Received or has Stopped Arriving	625	9	active	Advanced
J1939 CCVS Message is missing from either	527	9	not active	Refer to PSL
J1939 EBC1 Message is missing	973	9	not active	Refer to PSL
J1939 Message is missing from source address 11 (dec)	2011	9	not active	Refer to PSL
J1939 Message is missing from source address 23 (dec)	2023	9	not active	Refer to PSL
J1939-0 - Engine #1				
Accelerator Pedal Position 1 - Abnormal frequency, pulse width or p...	91	8	not active	Refer to OEM
Proprietary Network #1 - Special Instructions	625	14	not active	Refer to OEM
Accelerator Pedal #1 Channel 2 - Data erratic, intermitteent or incorr...	2623	2	not active	Refer to OEM
Engine Coolant Level - Voltage above normal or shorted high	111	3	not active	Refer to OEM
Sensor supply voltage 2 - Mechanical system not responding properly	3510	7	not active	Refer to OEM
Accelerator Pedal #1 Channel 2 - Abnormal frequency, pulse width o...	2623	8	not active	Refer to OEM

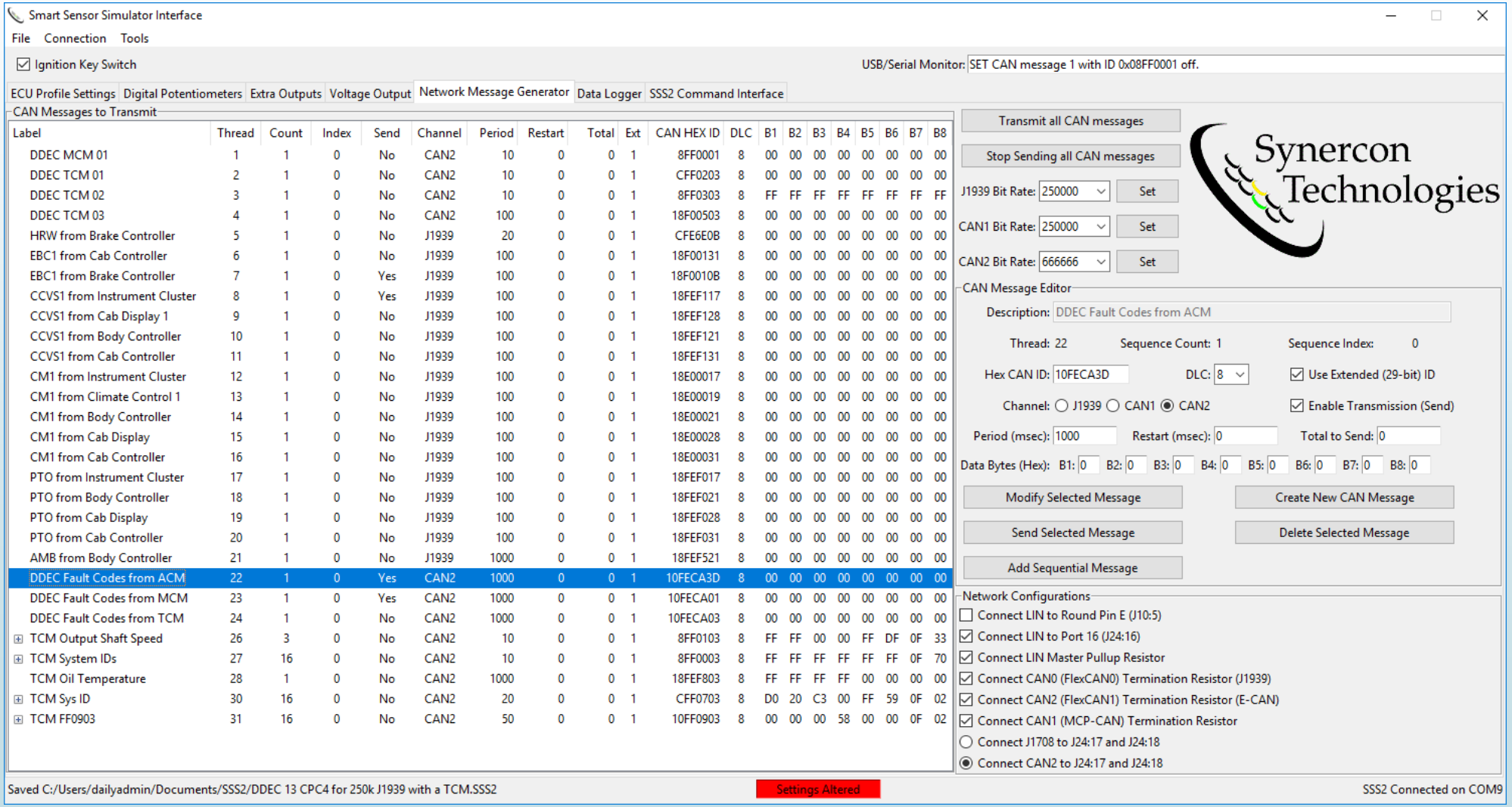
Engine or PT CAN Connections

- On many modern ECUs, there are multiple CAN channels
- For DDEC10 systems, the Common Powertrain Controller looks for messages from the Motor Control Module (MCM) and Aftertreatment Control Module (ACM)
- The SSS2 can simulate connections to the powertrain control modules
  - For DDEC13, Engine CAN is at 666,666 bits/sec
  - For DDEC10, Engine CAN is at 500,000 bits/sec
  - For DDEC 6 and Mercedes Benz, Engine CAN is at 125,000 bits/sec

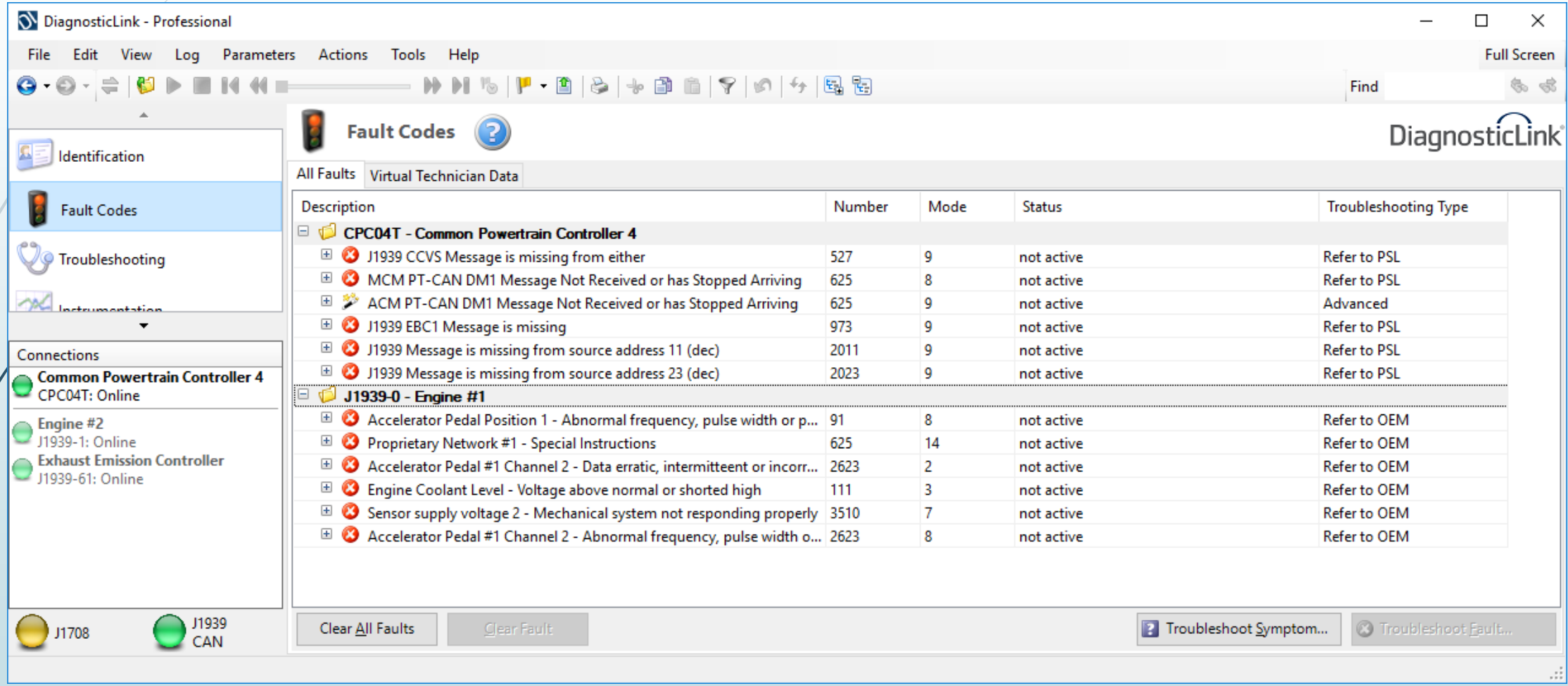


ACM and MCM Diagnostic Messages

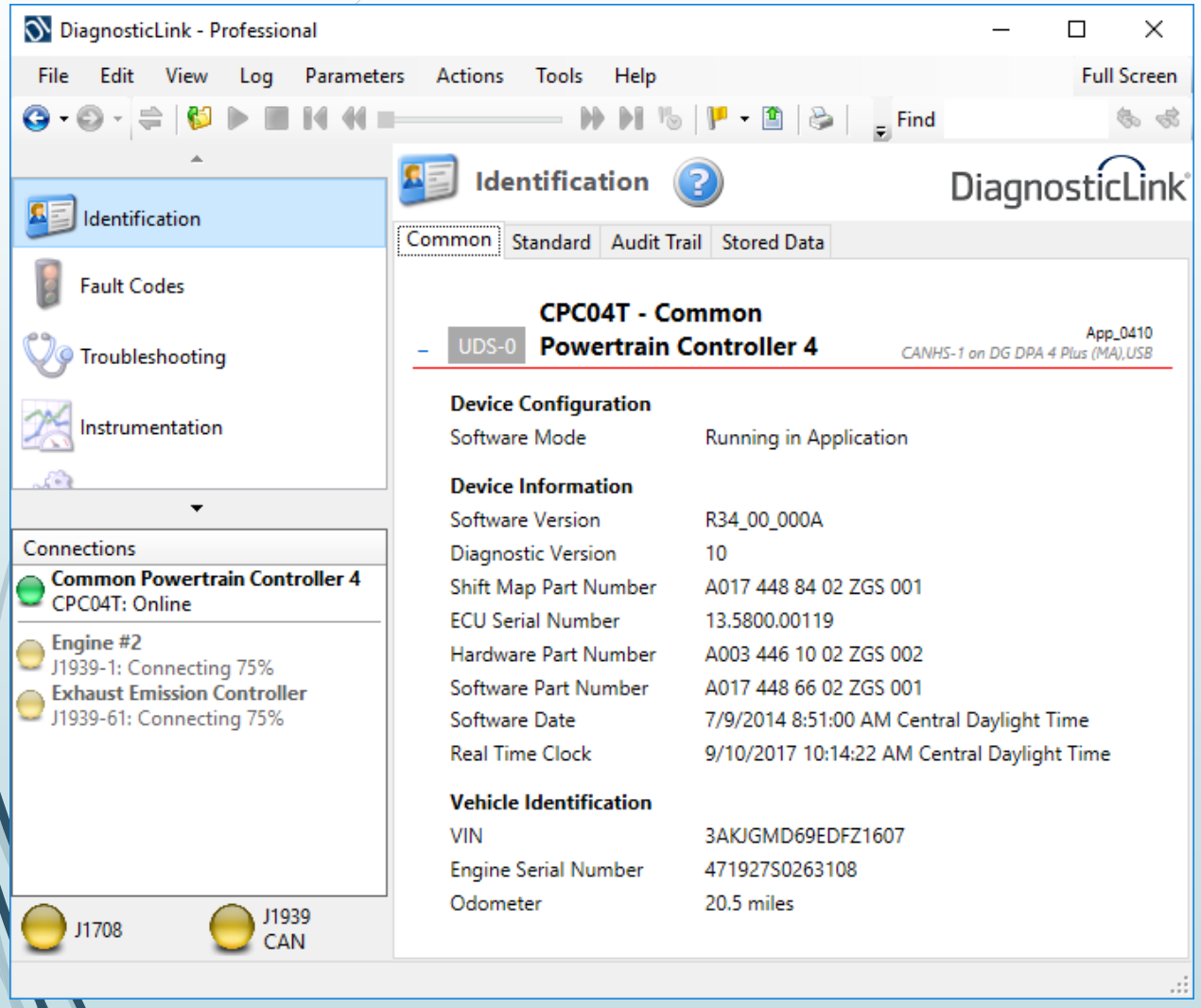
These proprietary CAN messages still use the J1939 DM1 message ID



All Codes are Cleared



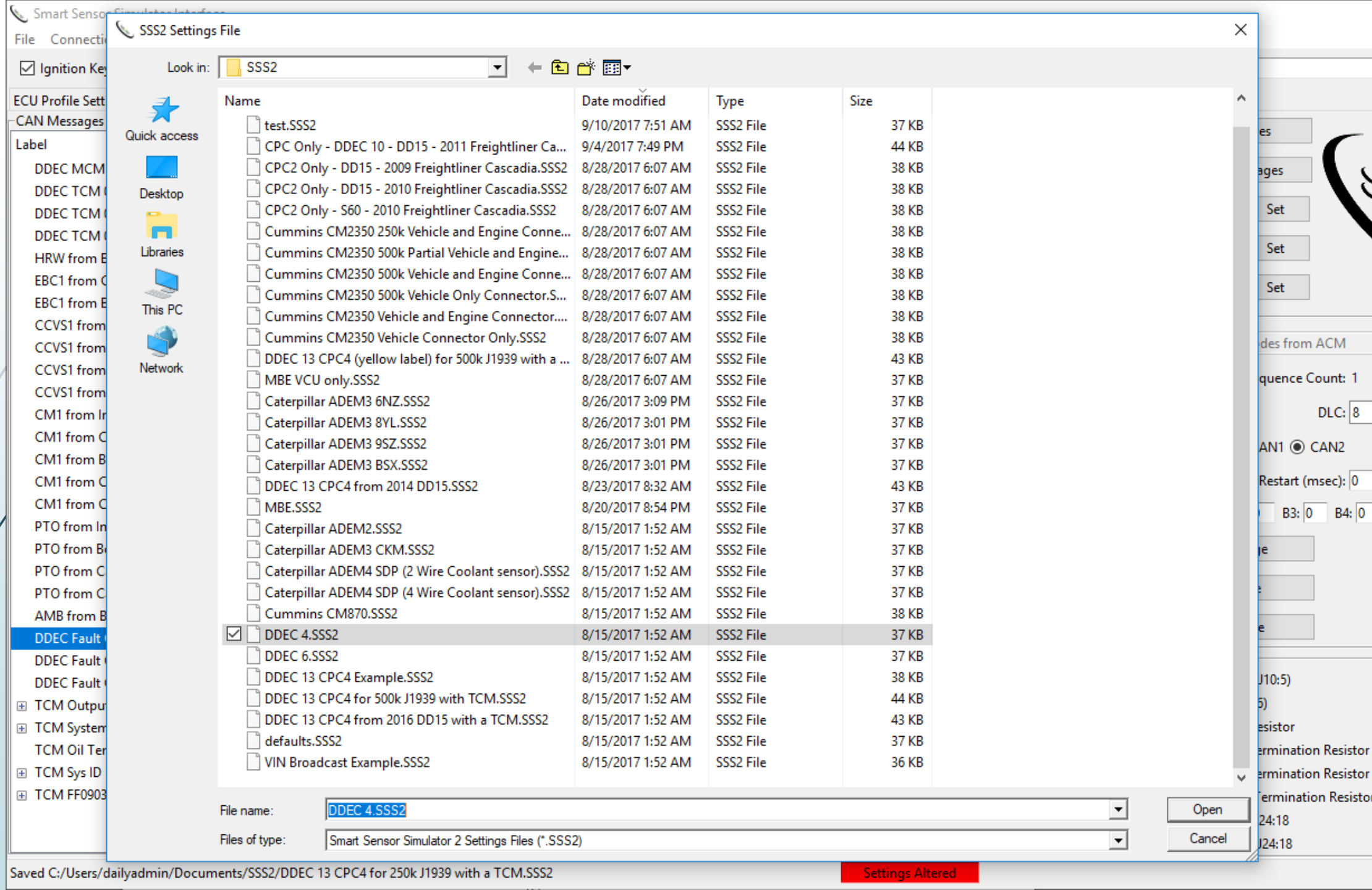
Example Limitations



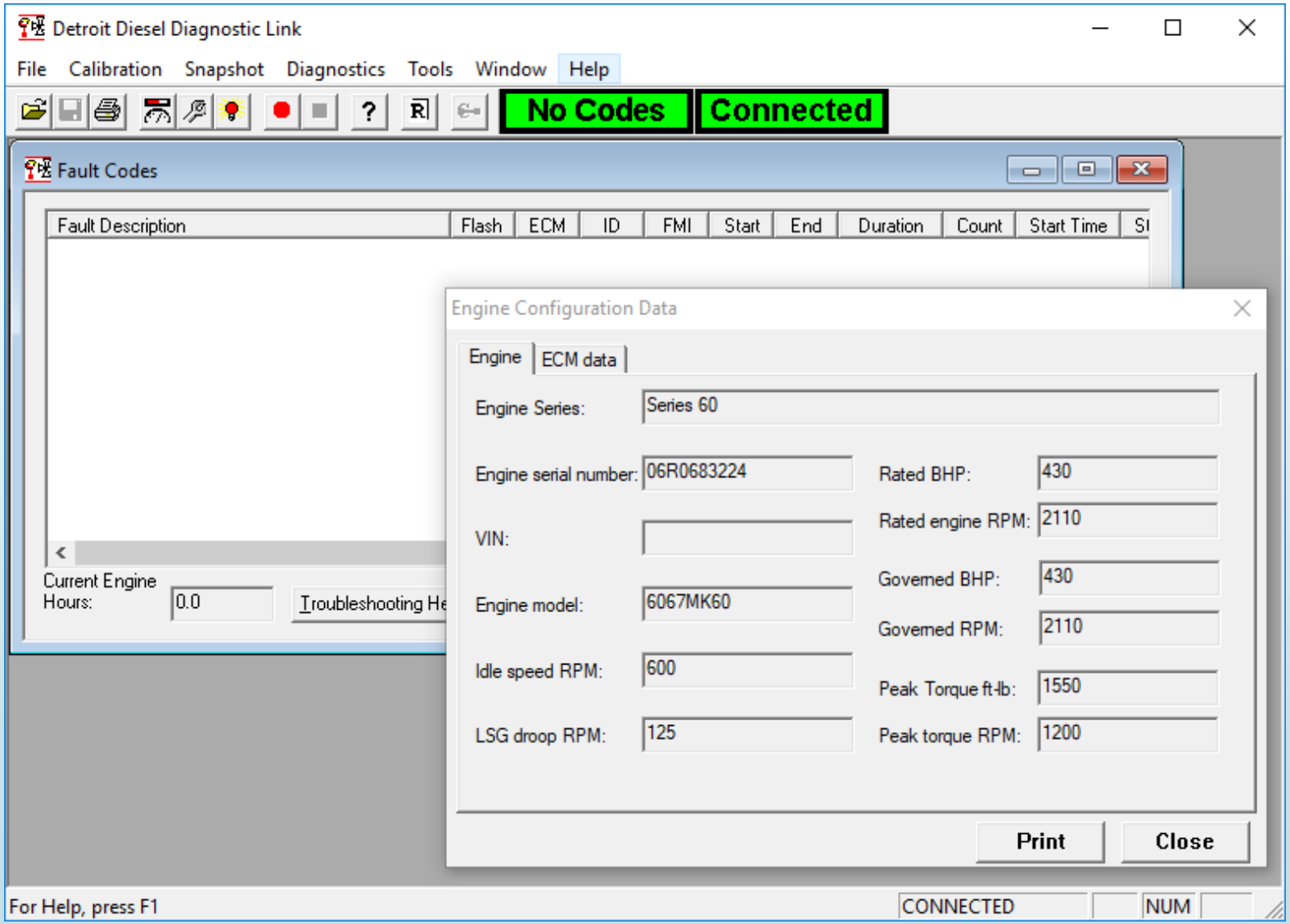
- This example worked for this particular module.
- Other CPC4 modules can be programmed to look for different CAN messages.
- Users can use Synercon Technologies' templates to build their own library of settings files.

Example of DDEC IV

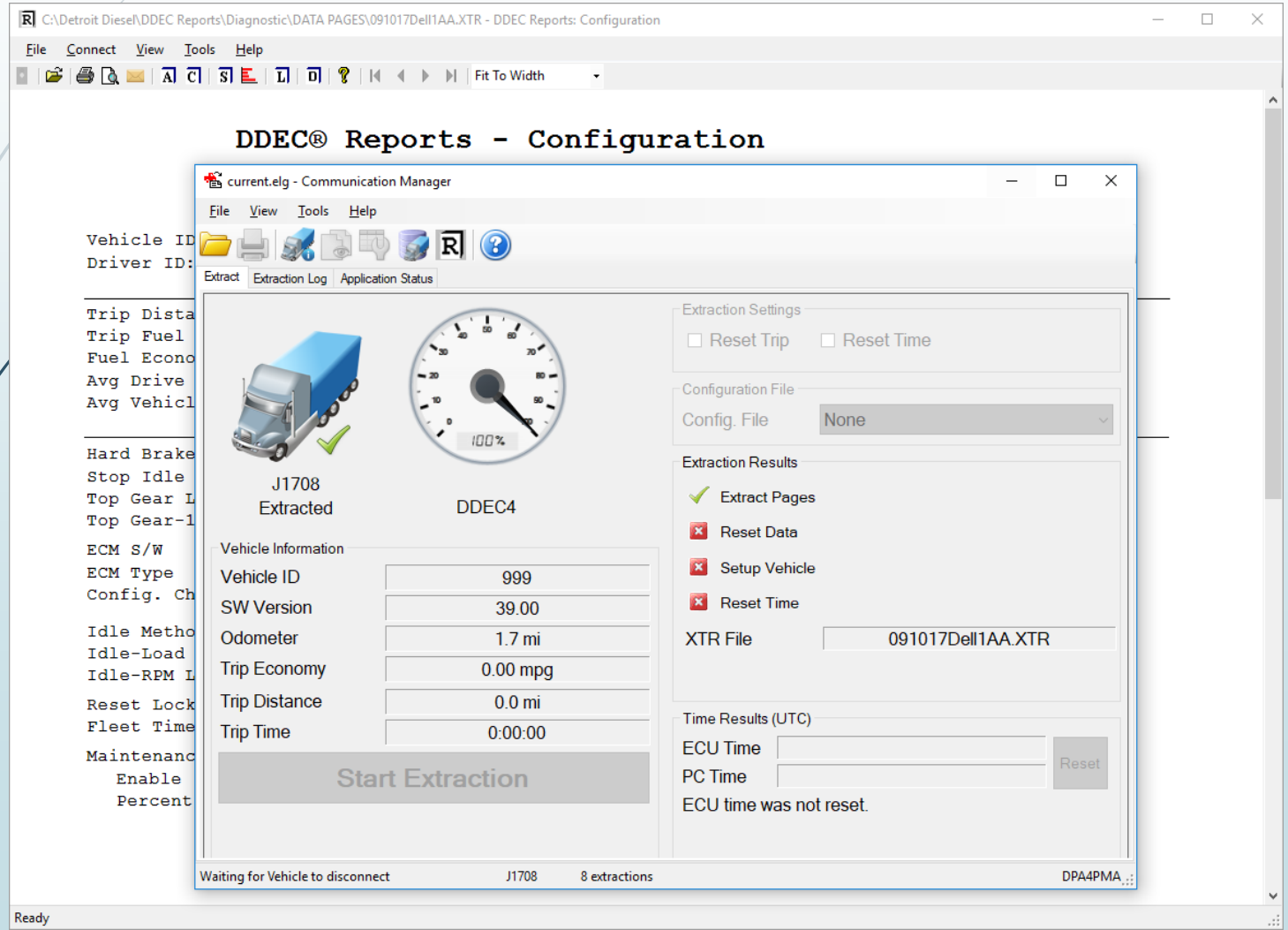
- Connect the DDEC IV
- Connect Power
- Connect USB
- Open the SSS2 Interface App


SSS2 Settings File
Look in: SSS2
Quick access
Desktop
Libraries
This PC
Network
Name
Date modified
Type
Size
test.SSS2 9/10/2017 7:51 AM SSS2 File 37 KB
CPC Only - DDEC 10 - DD15 - 2011 Freightliner Ca... 9/4/2017 7:49 PM SSS2 File 44 KB
CPC2 Only - DD15 - 2009 Freightliner Cascadia.SSS2 8/28/2017 6:07 AM SSS2 File 38 KB
CPC2 Only - DD15 - 2010 Freightliner Cascadia.SSS2 8/28/2017 6:07 AM SSS2 File 38 KB
CPC2 Only - S60 - 2010 Freightliner Cascadia.SSS2 8/28/2017 6:07 AM SSS2 File 38 KB
Cummins CM2350 250k Vehicle and Engine Conne... 8/28/2017 6:07 AM SSS2 File 38 KB
Cummins CM2350 500k Partial Vehicle and Engine... 8/28/2017 6:07 AM SSS2 File 38 KB
Cummins CM2350 500k Vehicle and Engine Conne... 8/28/2017 6:07 AM SSS2 File 38 KB
Cummins CM2350 500k Vehicle Only Connector.S... 8/28/2017 6:07 AM SSS2 File 38 KB
Cummins CM2350 Vehicle and Engine Connector.... 8/28/2017 6:07 AM SSS2 File 38 KB
Cummins CM2350 Vehicle Connector Only.SSS2 8/28/2017 6:07 AM SSS2 File 38 KB
DDEC 13 CPC4 (yellow label) for 500k J1939 with a ... 8/28/2017 6:07 AM SSS2 File 43 KB
MBE VCU only.SSS2 8/28/2017 6:07 AM SSS2 File 37 KB
Caterpillar ADEM3 6NZ.SSS2 8/26/2017 3:09 PM SSS2 File 37 KB
Caterpillar ADEM3 8YL.SSS2 8/26/2017 3:01 PM SSS2 File 37 KB
Caterpillar ADEM3 9SZ.SSS2 8/26/2017 3:01 PM SSS2 File 37 KB
Caterpillar ADEM3 BSX.SSS2 8/26/2017 3:01 PM SSS2 File 37 KB
DDEC 13 CPC4 from 2014 DD15.SSS2 8/23/2017 8:32 AM SSS2 File 43 KB
MBE.SSS2 8/20/2017 8:54 PM SSS2 File 37 KB
Caterpillar ADEM2.SSS2 8/15/2017 1:52 AM SSS2 File 37 KB
Caterpillar ADEM3 CKM.SSS2 8/15/2017 1:52 AM SSS2 File 37 KB
Caterpillar ADEM4 SDP (2 Wire Coolant sensor).SSS2 8/15/2017 1:52 AM SSS2 File 37 KB
Caterpillar ADEM4 SDP (4 Wire Coolant sensor).SSS2 8/15/2017 1:52 AM SSS2 File 37 KB
Cummins CM870.SSS2 8/15/2017 1:52 AM SSS2 File 38 KB
DDEC 4.SSS2 8/15/2017 1:52 AM SSS2 File 37 KB
DDEC 6.SSS2 8/15/2017 1:52 AM SSS2 File 37 KB
DDEC 13 CPC4 Example.SSS2 8/15/2017 1:52 AM SSS2 File 38 KB
DDEC 13 CPC4 for 500k J1939 with TCM.SSS2 8/15/2017 1:52 AM SSS2 File 44 KB
DDEC 13 CPC4 from 2016 DD15 with a TCM.SSS2 8/15/2017 1:52 AM SSS2 File 43 KB
defaults.SSS2 8/15/2017 1:52 AM SSS2 File 37 KB
VIN Broadcast Example.SSS2 8/15/2017 1:52 AM SSS2 File 36 KB
File name: DDEC 4.SSS2
Files of type: Smart Sensor Simulator 2 Settings Files (*.SSS2)
Open
Cancel
Ignition Key
ECU Profile Sett
CAN Messages
Label
DDEC MCM
DDEC TCM
DDEC TCM
DDEC TCM
HRW from E
EBC1 from C
EBC1 from E
CCVS1 from
CCVS1 from
CCVS1 from
CCVS1 from
CM1 from In
CM1 from C
CM1 from B
CM1 from C
CM1 from C
PTO from In
PTO from B
PTO from C
PTO from C
AMB from B
DDEC Fault
DDEC Fault
DDEC Fault
TCM Outpu
TCM Systen
TCM Oil Ter
TCM Sys ID
TCM FF0903
Set
Set
Set
des from ACM
quence Count: 1
DLC: 8
AN1 CAN2
Restart (msec): 0
B3: 0 B4: 0
Saved C:/Users/dailyadmin/Documents/SSS2/DDEC 13 CPC4 for 250k J1939 with a TCM.SSS2
Settings Altered

DDDL 6 Shows No Codes



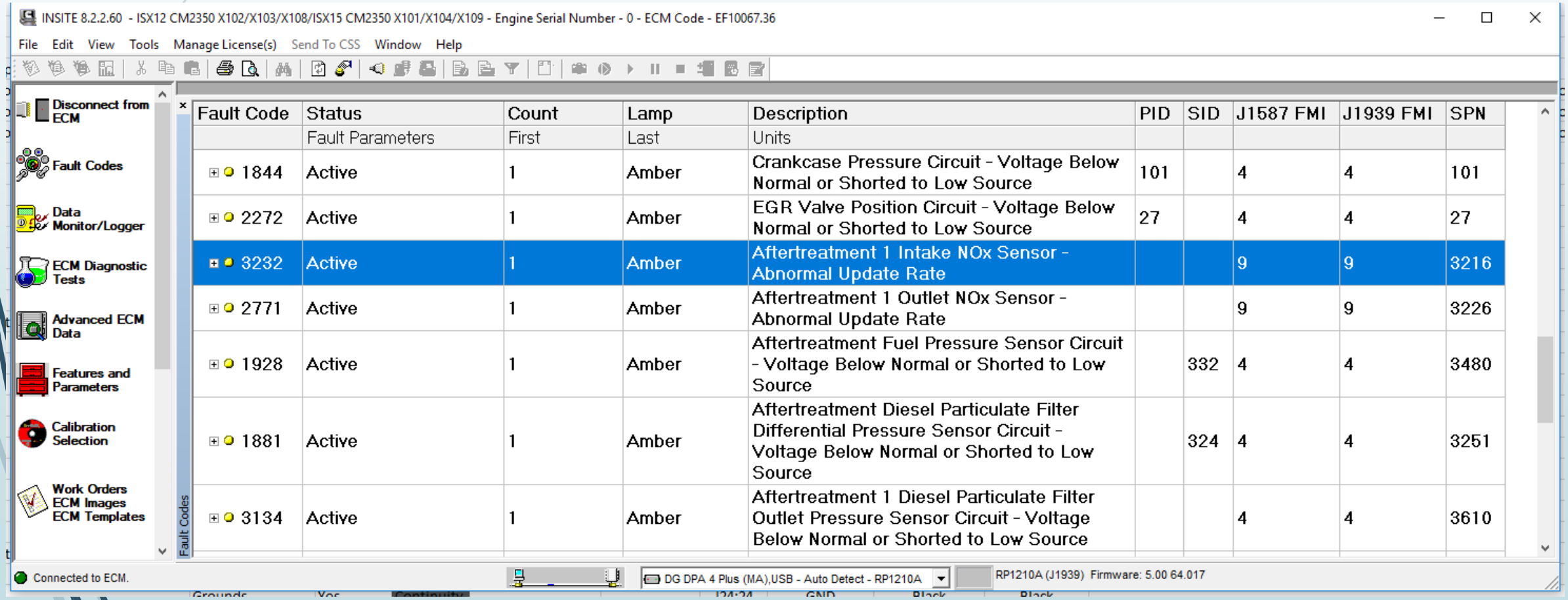
Download Data With the Forensic Link Adapter and/or DDEC Reports



Using an SSS2 with the SSS2-DDEC4 cable and DDEC4.SSS2 Settings file yields a fault free download and preserves the Diagnostic Records in DDEC Reports.

Generating a New CAN Message

- Aftertreatment Systems communicate to ECMs over CAN.
- Use a Cummins CM2350 as an example to eliminate a fault code related to the Aftertreatment 1 Intake message.



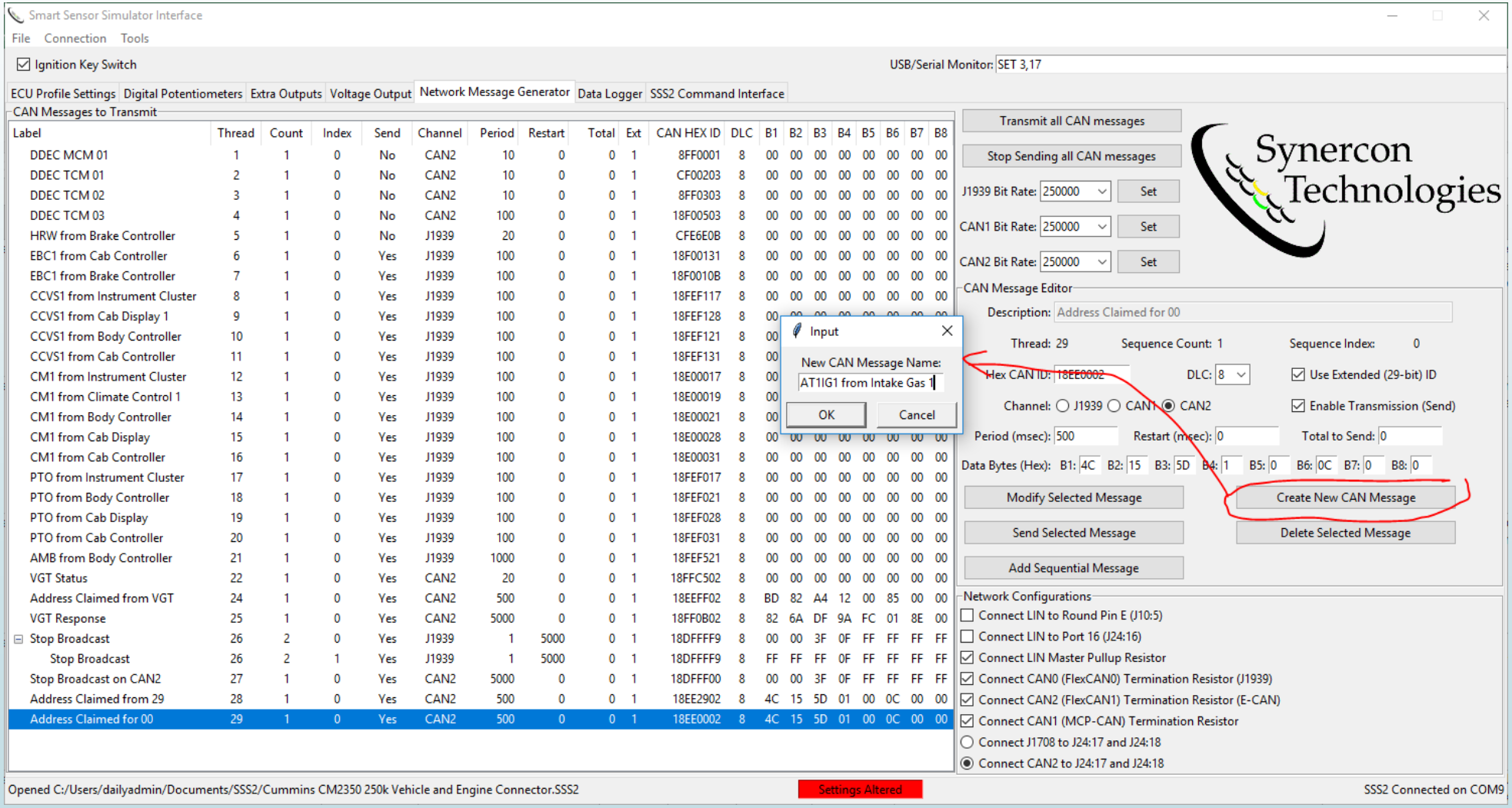
Fault Code	Status	Count	Lamp	Description	PID	SID	J1587 FMI	J1939 FMI	SPN
	Fault Parameters	First	Last	Units					
1844	Active	1	Amber	Crankcase Pressure Circuit - Voltage Below Normal or Shorted to Low Source	101		4	4	101
2272	Active	1	Amber	EGR Valve Position Circuit - Voltage Below Normal or Shorted to Low Source	27		4	4	27
3232	Active	1	Amber	Aftertreatment 1 Intake NOx Sensor - Abnormal Update Rate			9	9	3216
2771	Active	1	Amber	Aftertreatment 1 Outlet NOx Sensor - Abnormal Update Rate			9	9	3226
1928	Active	1	Amber	Aftertreatment Fuel Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source		332	4	4	3480
1881	Active	1	Amber	Aftertreatment Diesel Particulate Filter Differential Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source		324	4	4	3251
3134	Active	1	Amber	Aftertreatment 1 Diesel Particulate Filter Outlet Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source			4	4	3610

Look Up the Aftertreatment 1 Intake Messages in J1939

PGN	PGN (Hex)	Acronym	Parameter Group Label	Transmission Rate
61454	0xF00E	AT1IG1	Aftertreatment 1 Intake Gas 1	50 ms
64948	0XFDB4	AT1IG2	Aftertreatment 1 Intake Gas 2	500 ms

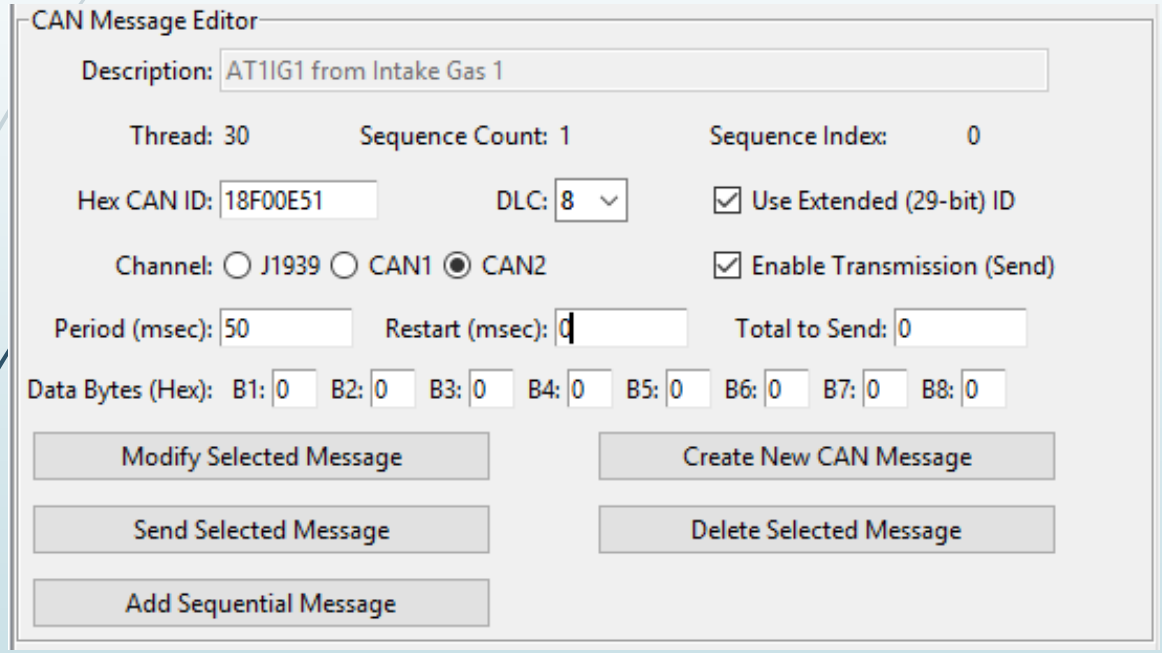
- Source address is decimal 81 (0x51) for the Aftertreatment #1 system gas intake module
- Priority will be 6 (typical).
- The CAN IDs on CAN2 will be
  - 0x18F00E51
  - 0x18FDB451

Create New CAN Message and Give a Descriptive Name



Use the CAN Message Editor

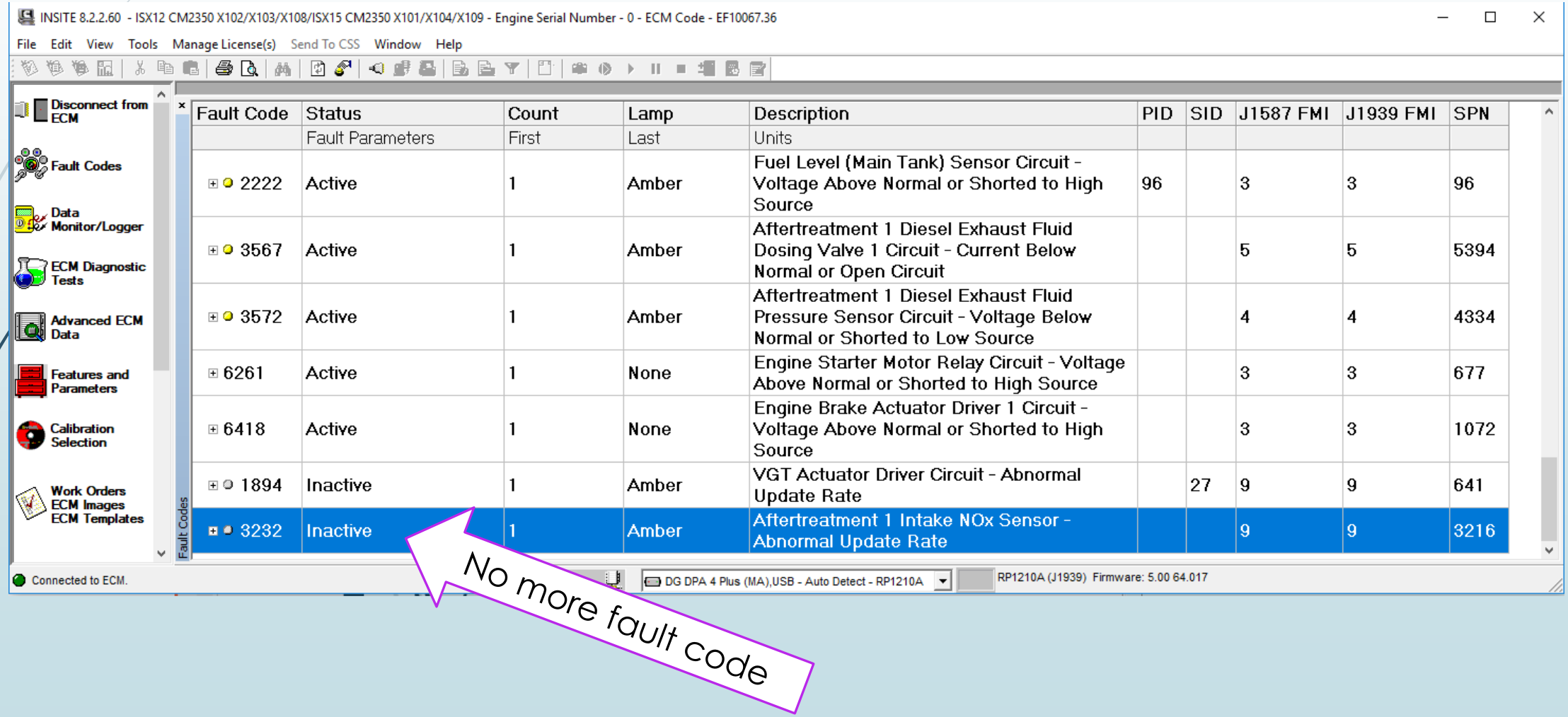
AT1IG1 from Intake Gas 1	30	1	0	Yes	CAN2	50	0	0	1	18F00E51	8	00	00	00	00	00	00	00	00



- Add Sequential Message sets up message bursts with potentially different contents (See upcoming VIN example).

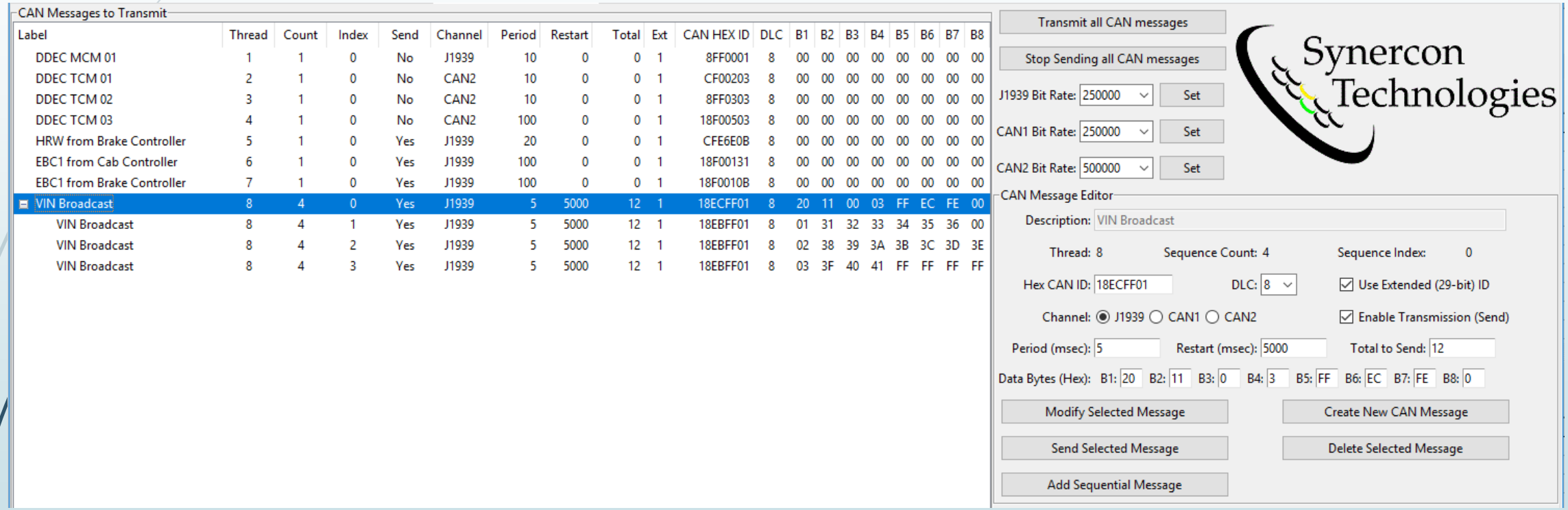
- Tab or Enter sends the changes to the SSS2
- Pressing Modify Selected Message sends changes to the SSS2
- Selecting the message fills the CAN Message Editor
- Period is the time gap between sequential messages
- Restart is the delay before starting over again (leave at 0 for single messages)
- If Total to Send is 0, then there is no limit.
- Individual messages can be toggled with the Enable Transmission box
- Send Selected Message starts the Total counter over again.

Eliminated Fault Code from Missing CAN Message

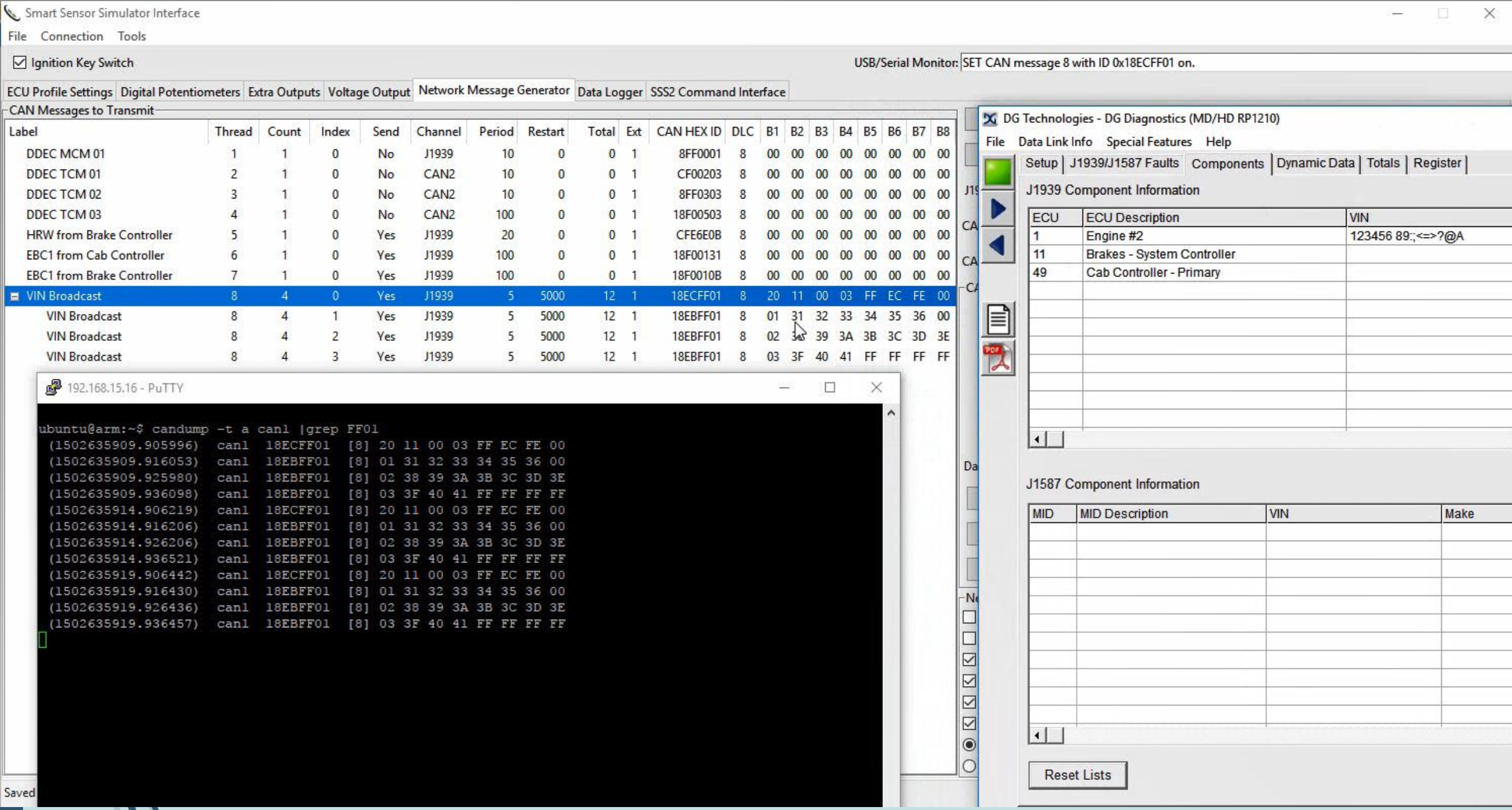


Fault Code	Status	Count	Lamp	Description	PID	SID	J1587 FMI	J1939 FMI	SPN
	Fault Parameters	First	Last	Units					
2222	Active	1	Amber	Fuel Level (Main Tank) Sensor Circuit - Voltage Above Normal or Shorted to High Source	96		3	3	96
3567	Active	1	Amber	Aftertreatment 1 Diesel Exhaust Fluid Dosing Valve 1 Circuit - Current Below Normal or Open Circuit			5	5	5394
3572	Active	1	Amber	Aftertreatment 1 Diesel Exhaust Fluid Pressure Sensor Circuit - Voltage Below Normal or Shorted to Low Source			4	4	4334
6261	Active	1	None	Engine Starter Motor Relay Circuit - Voltage Above Normal or Shorted to High Source			3	3	677
6418	Active	1	None	Engine Brake Actuator Driver 1 Circuit - Voltage Above Normal or Shorted to High Source			3	3	1072
1894	Inactive	1	Amber	VGT Actuator Driver Circuit - Abnormal Update Rate		27	9	9	641
3232	Inactive	1	Amber	Aftertreatment 1 Intake NOx Sensor - Abnormal Update Rate			9	9	3216

Generating a Burst of CAN Messages: Vehicle Identification Number Example



VIN Broadcast Example.SSS2 is available with the SSS2 Interface Application.



Link: http://www.synercontechnologies.com/files/Training/VIN%20Broadcast%20Example.mp4

Additional Ideas

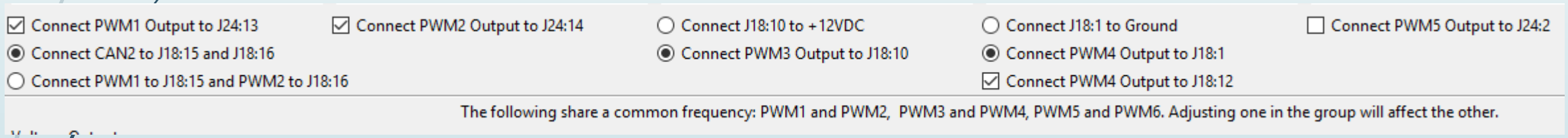
- You can connect multiple SSS2 Units together and run them with the same computer.
  - Each SSS2 has a unique COM port.
  - Each SSS2 should have its own SSS2 Interface Application running.
  - May be useful to connect brake and body controller together.
- Detroit Diesel DDEC MCM and ACM cables connect 21 Pin Connectors to the SSS2 9-pin.
  - ACM and MCM will set new faults
  - Enables extraction of additional parameters and engine related data
  - Recommend to do CPC only first, then connect to MCM and ACM
  - CPC is required for ACM and MCM connections.
  - DDEC Reports data is on the CPC

Troubleshooting

A brief guide on making sure things work.

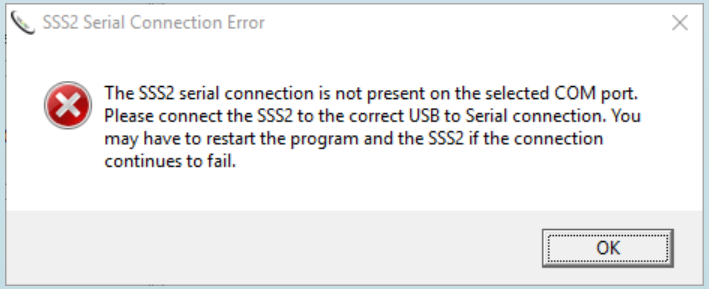
Troubleshooting
Messages or Signals are not Present

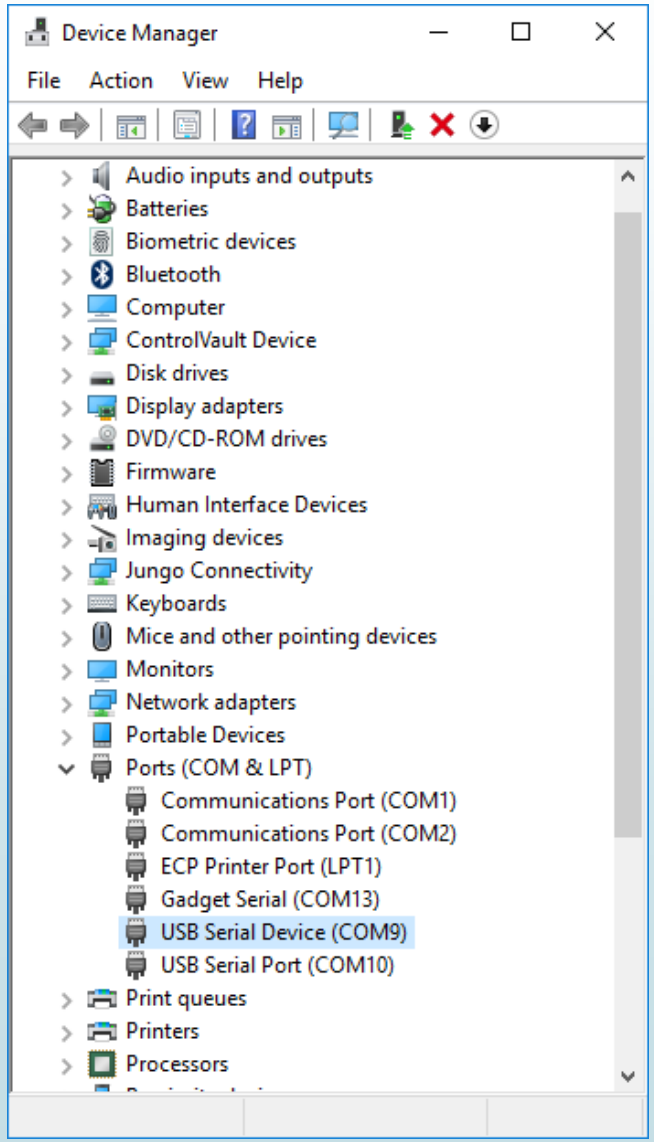
- Check to be sure the pin multiplexing is not blocking a signal.
- Radio buttons and Checkboxes perform the multiplexing.
- Some pin settings are on different tabs than their signal settings.

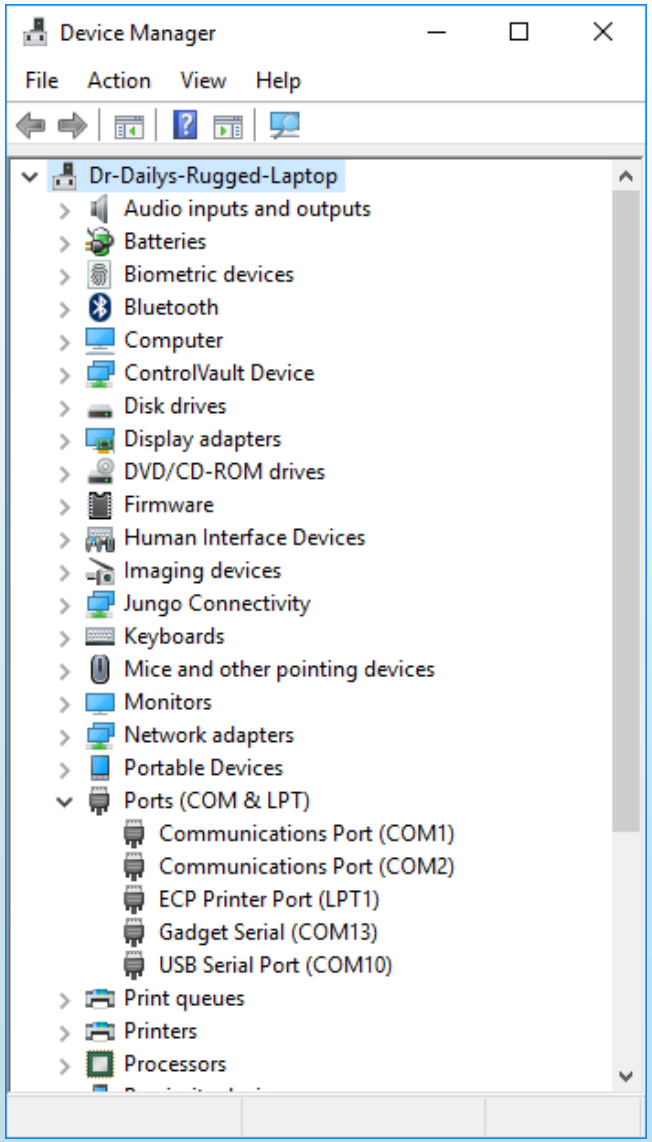


Troubleshooting

- The SSS2 Interface Application is designed to have the SSS2 connected by USB with the Virtual Serial driver installed.
  - Be sure the SSS2 has its own COM port.
  - Unplug SSS2 to see which port goes away (COM9 in this example)
- SSS2 Interface App detects missing communications.

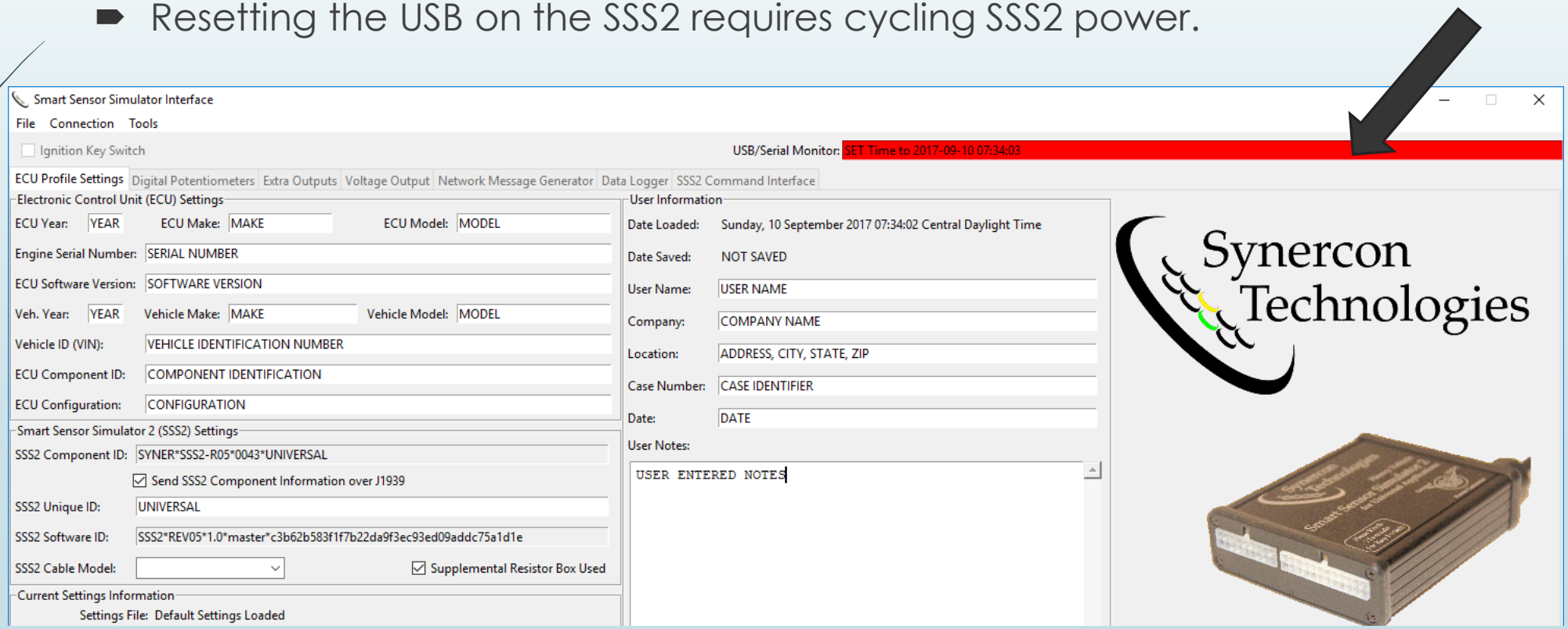






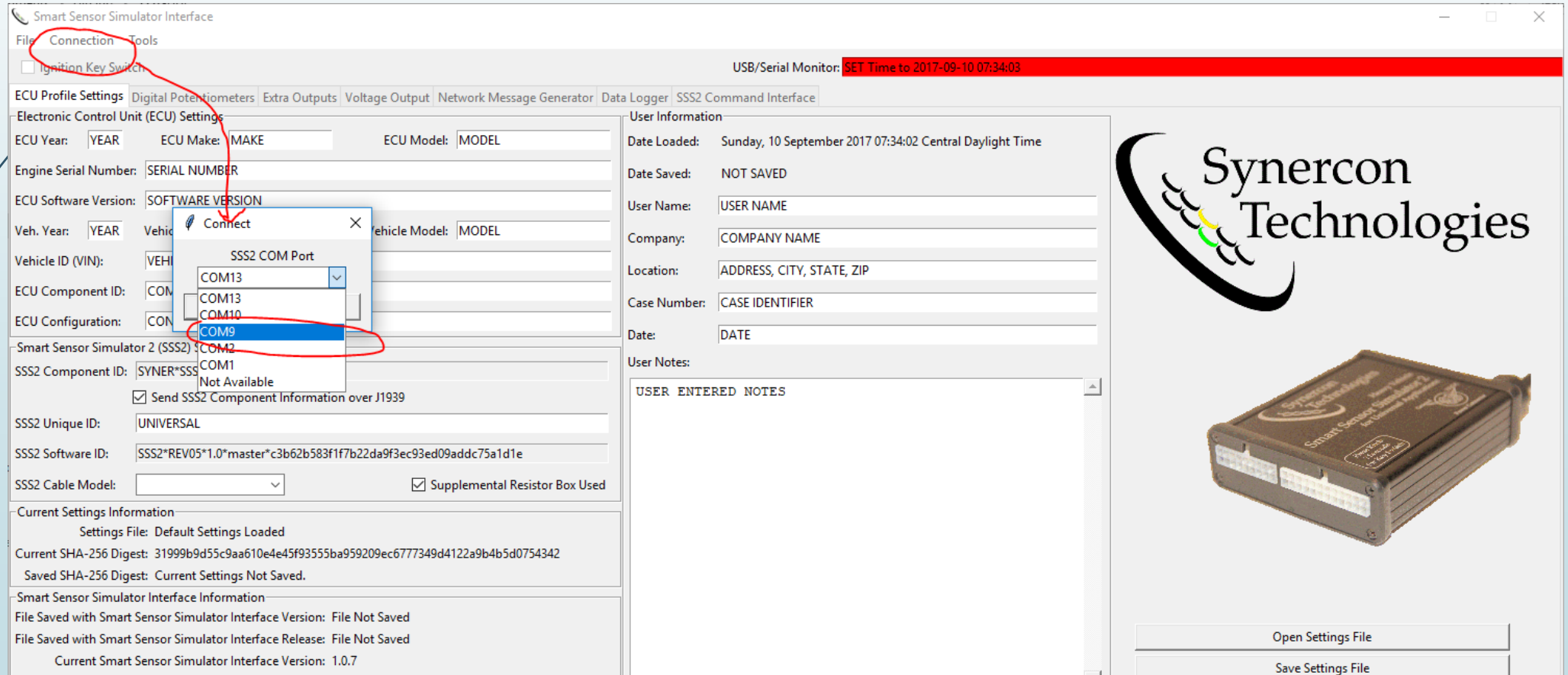
Troubleshooting

- A red background in the USB/Serial Monitor indicates no SSS2 communications
- Resetting the USB on the SSS2 requires cycling SSS2 power.



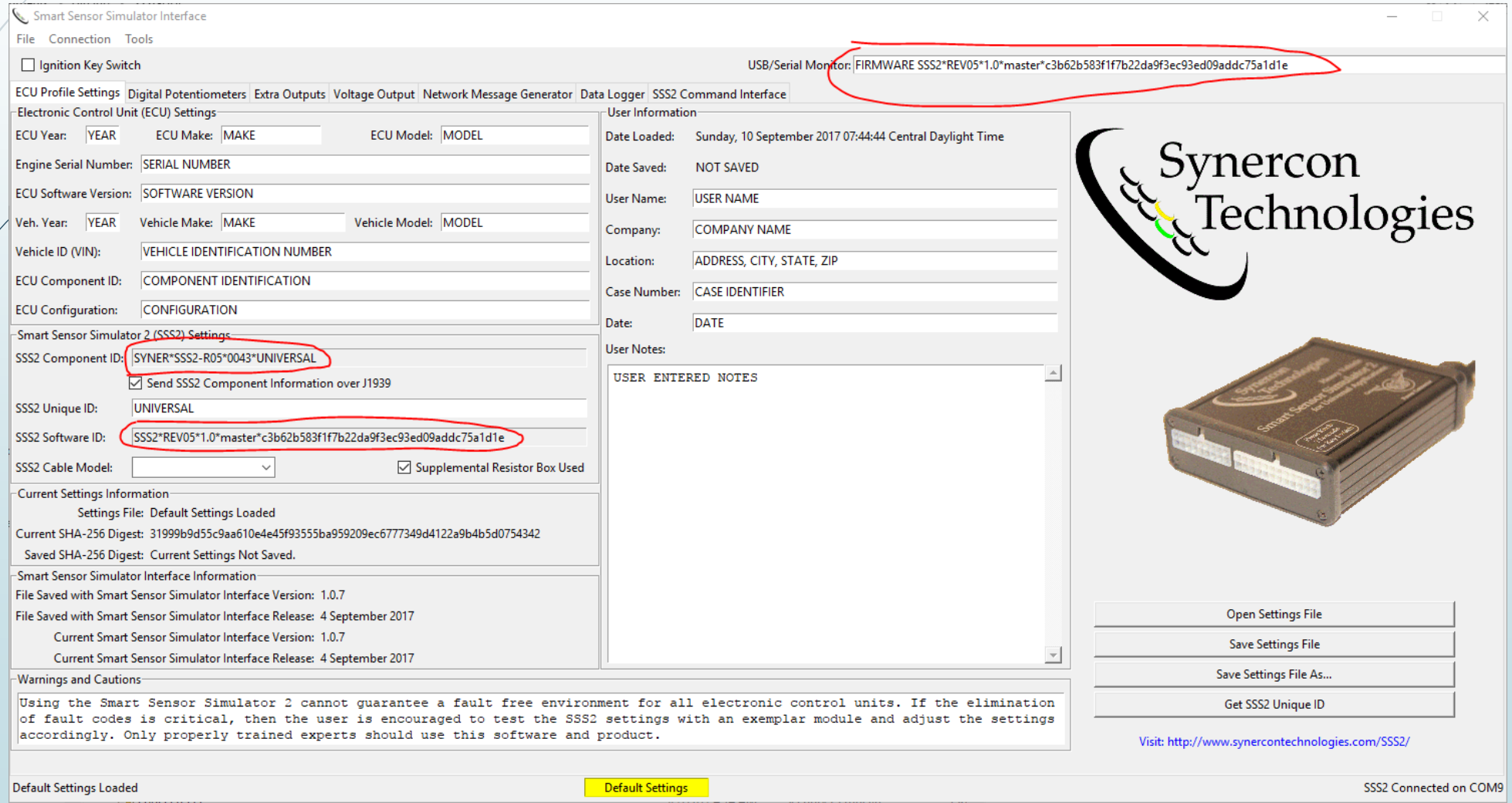
Troubleshooting

- Try reconnecting to the SSS2 with the correct COM Port.

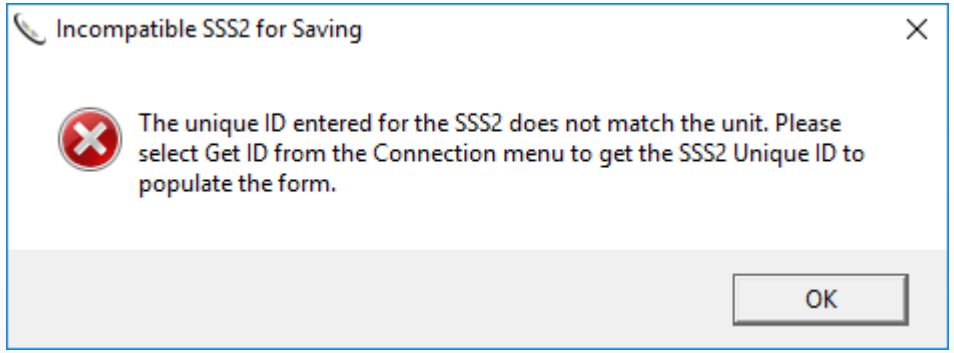


Troubleshooting

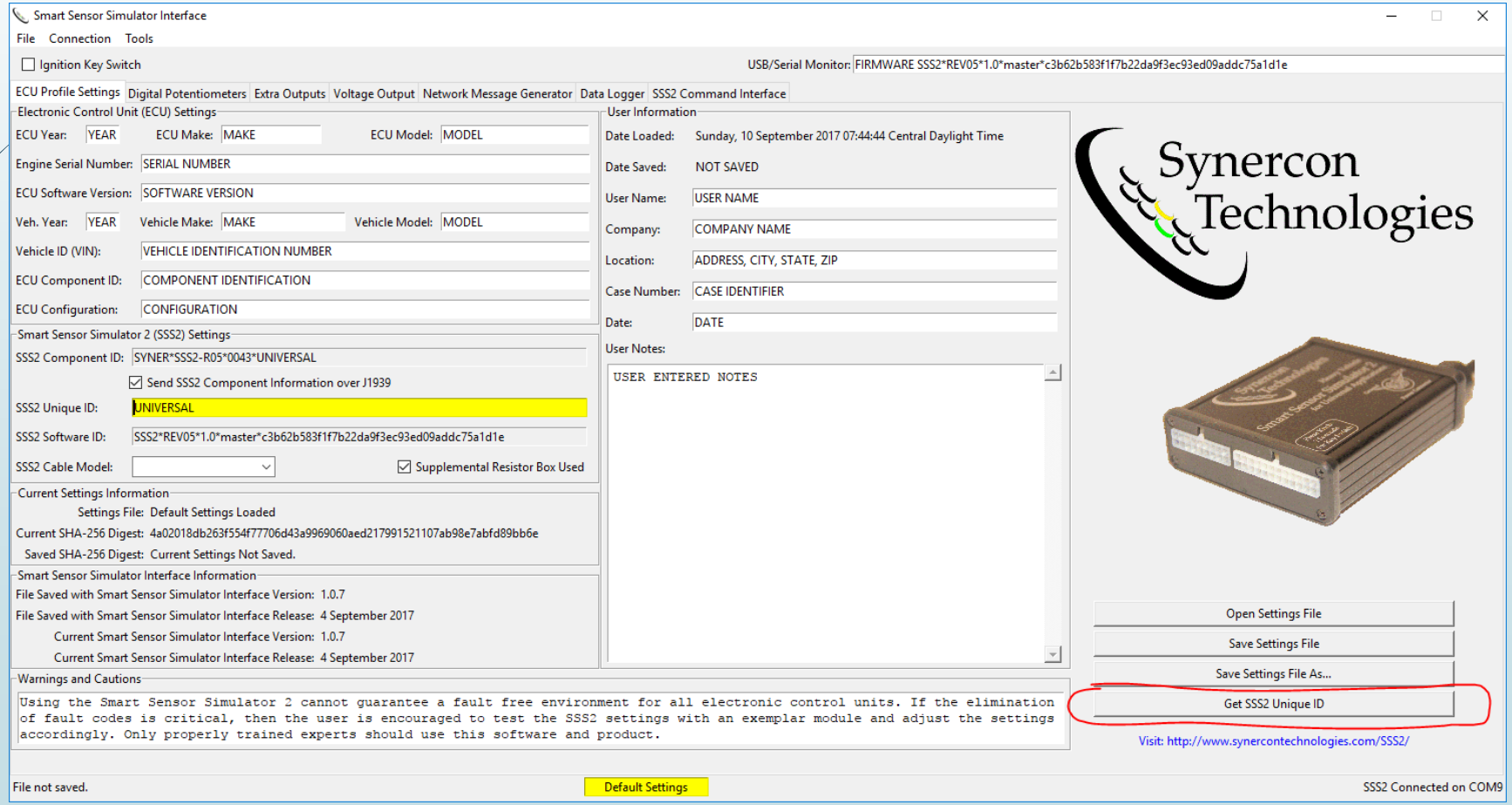
- Data from the SSS2 will show up in theUSB/Serial Monitor, Component ID, and Software ID fields when connected.



Troubleshooting

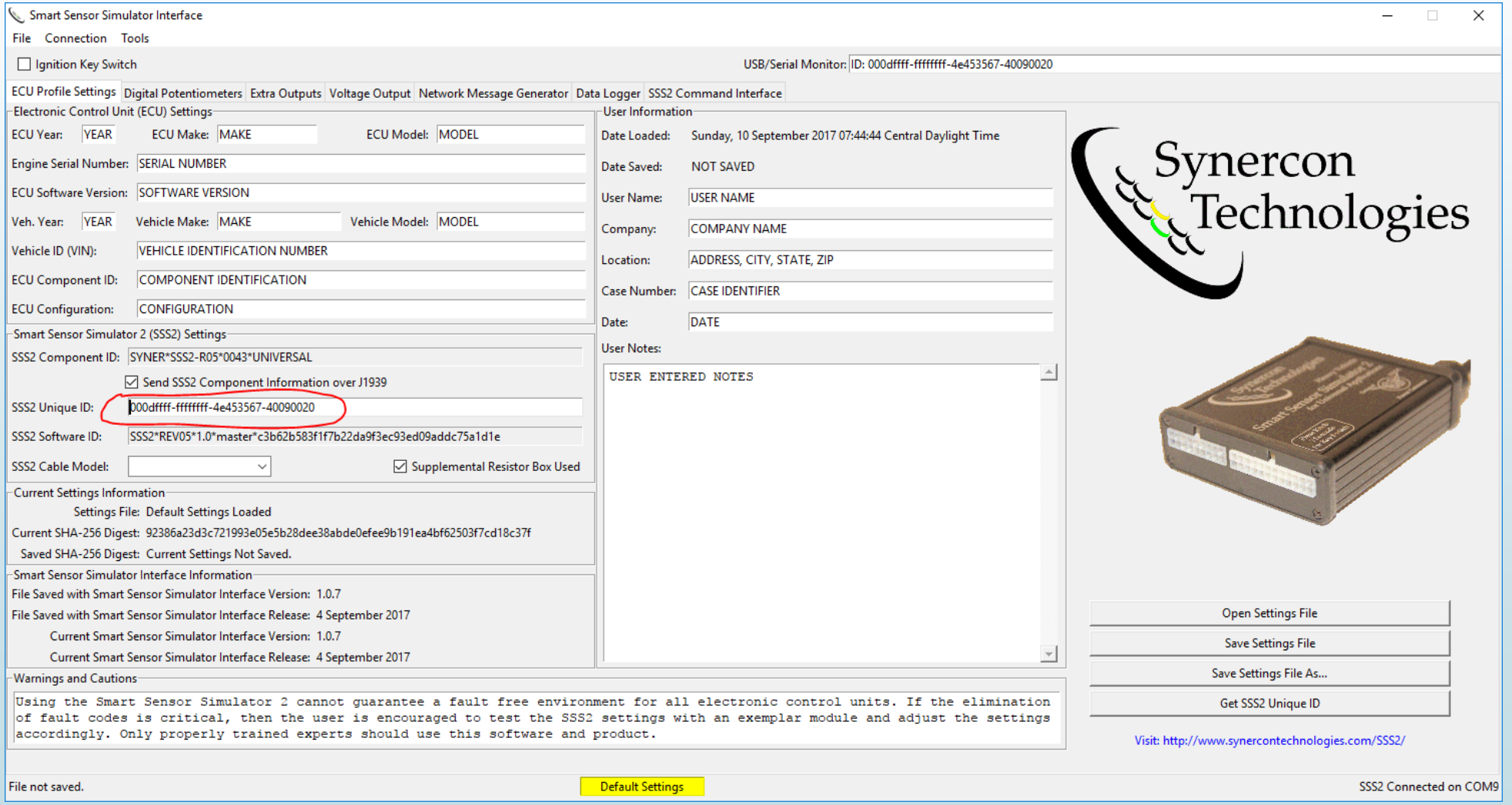


- Saving and Opening requires the SSS2 Unique ID.



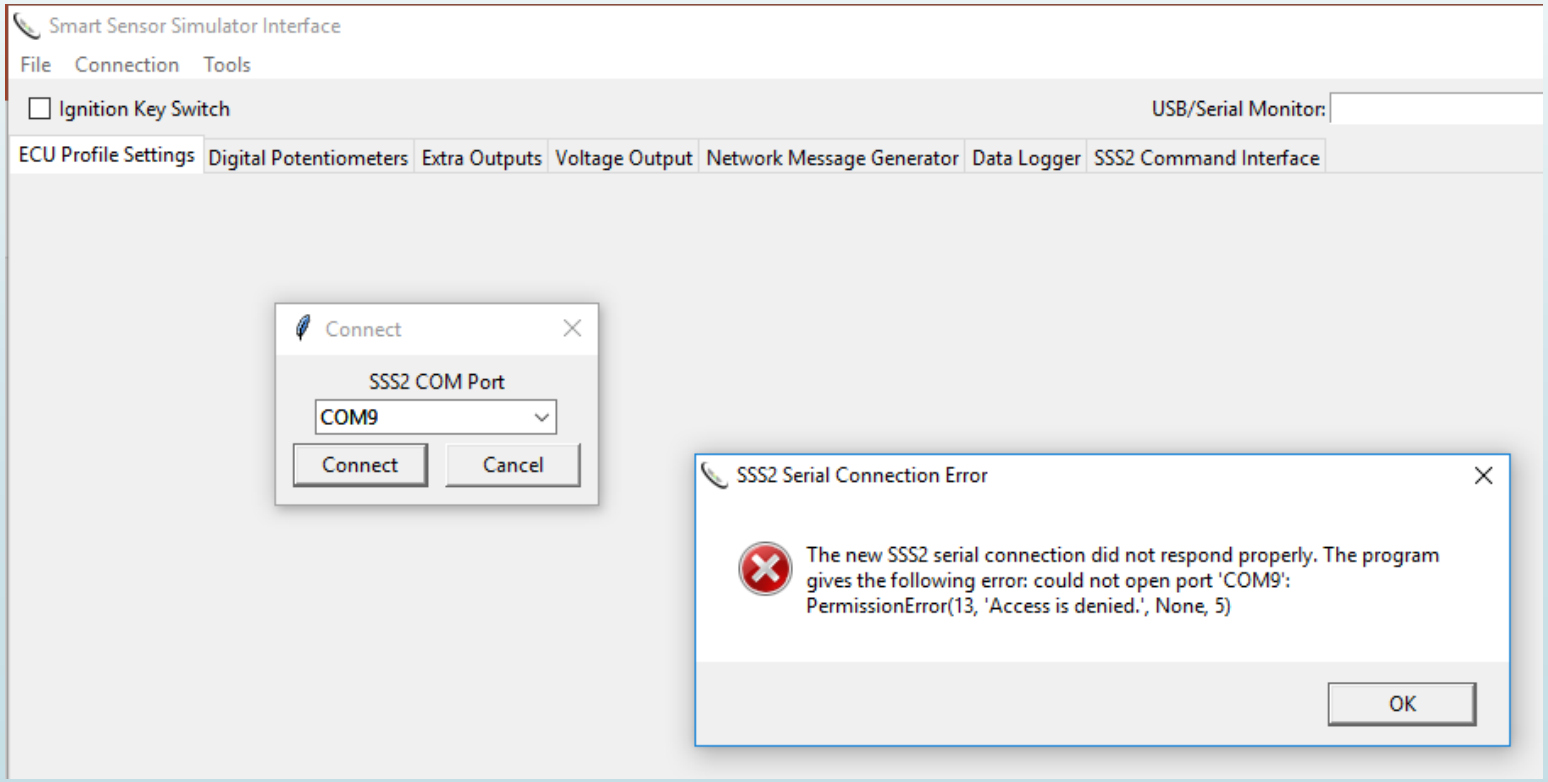
Troubleshooting

- The Unique ID is built into the SSS2 processor.



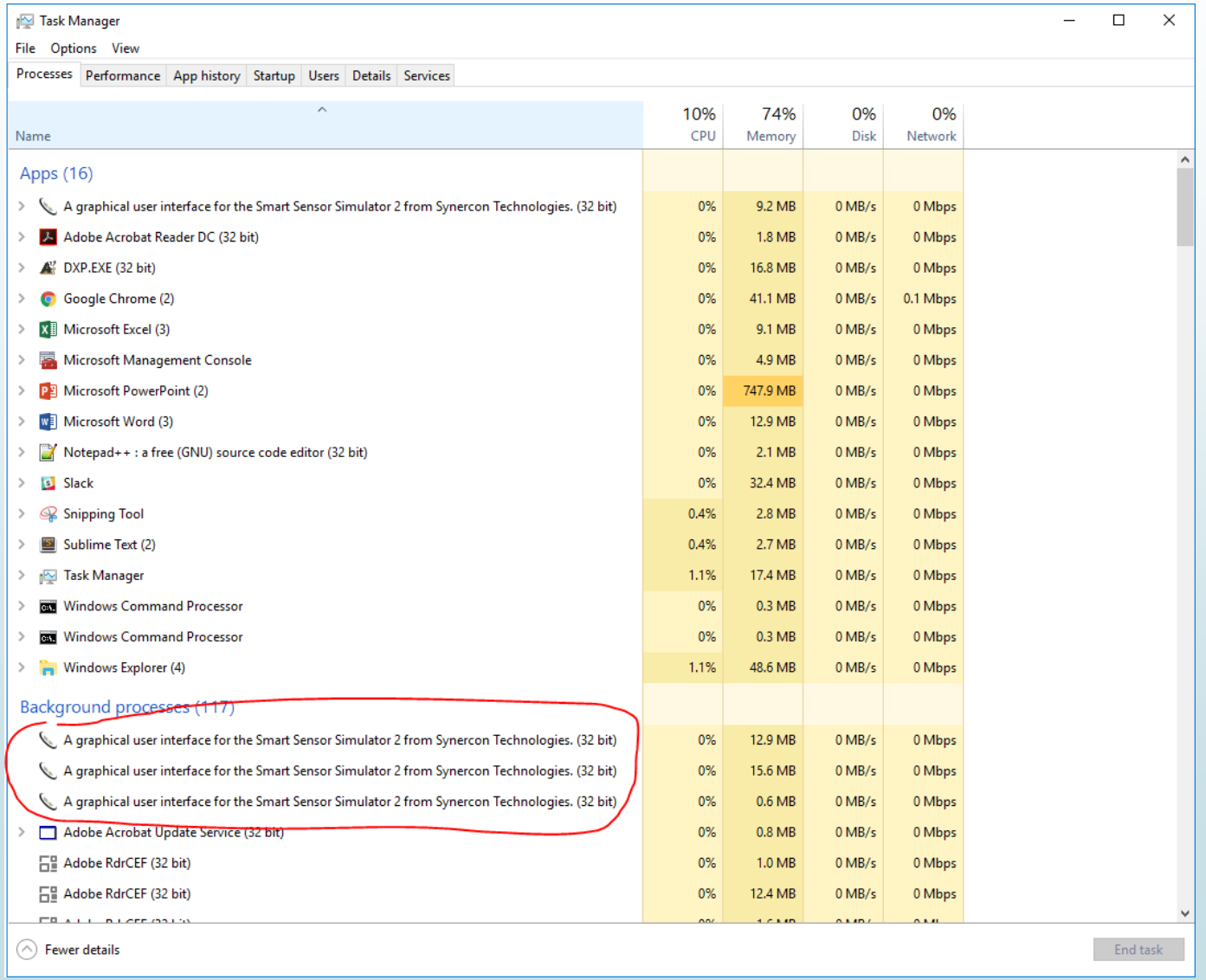
Troubleshooting

- A permission error means there is likely another program (or instance of the SSS2) that is using the COM port.



Troubleshooting

- Open the Task Manager and End Tasks for all SSS2 Interface App instances.
- Restart the program.



For More Information

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