

Profile

ServoTech Industries

Air Pollution technology, Solution and Systems Profile

Urban Air Quality management Plan

Mobile & Off Road Emissions Control Systems and Technologies

Industrial & Stationary Air pollution Control Systems

EGU Required Air pollution Control Systems

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www.servotechco.com

+1-734-697-5555



Products & Technology Presentation



**Since
1982**

Mobile Applications: Emissions Control System

- Zero Emission Mile Technology
- Gasoline / Petrol Engines
 - Total Powertrain / Emissions
 - Testing / Certification
- Diesel Engines Applications
 - On Road
 - Off Road
 - Construction
- CNG / Propane Fuels
 - OEM
 - Retrofit
- Hybrid Vehicles
 - Control Strategy
- Engineering & Testing

ServoTech Industries Air Pollution technology, Solution and Systems for Mobile Sources

ServoTech Industries, a Ford Q1 award recipient, has been a Prime Mover in the exhaust and stack emissions control technologies. ServoTech is a world leader working for a cleaner and safer environment. ServoTech has provided highly efficient solutions to Mobile and the retrofit / aftermarket industries achieving their emissions reduction goals and standards such as PZEV (gasoline) and diesel SCR / DPF.

- 1987 to1990 provided automotive industries with enabling powertrain control systems and strategies
- 1991to1999 provided exhaust emissions technologies and controlling software for gasoline engines enabling the OEMs achieving California Air Resource Board and USA EPA regulations compliance.
- 2000 to 2003 commissioned by Ford Motor Company to develop diesel engine emissions control technologies to reduce NOx and PM. Developed the world's first urea injector for NOx reduction.
- 2003 to 2008 developed emissions control technologies for off-road and heavy construction equipment. Awarded a grant from California Air Resource Board to further enhancement of the emissions reduction technologies for construction / off road applications.
- 2008 to Present: Alternative Fuels, Electrical Cars and Trucks System



Mobile Applications : OEM Supplier

- OEM Supplier with Vendor Codes:
 - Ford Motor Company: Since 1987
 - FCA: Since 1999
 - General Motors: Since 2006
- Ford Motor Company Q1 Certificate
- Ford Motor Company Licensee
 - AdBlue / Urea Injection System
 - Diesel Exhaust Control System

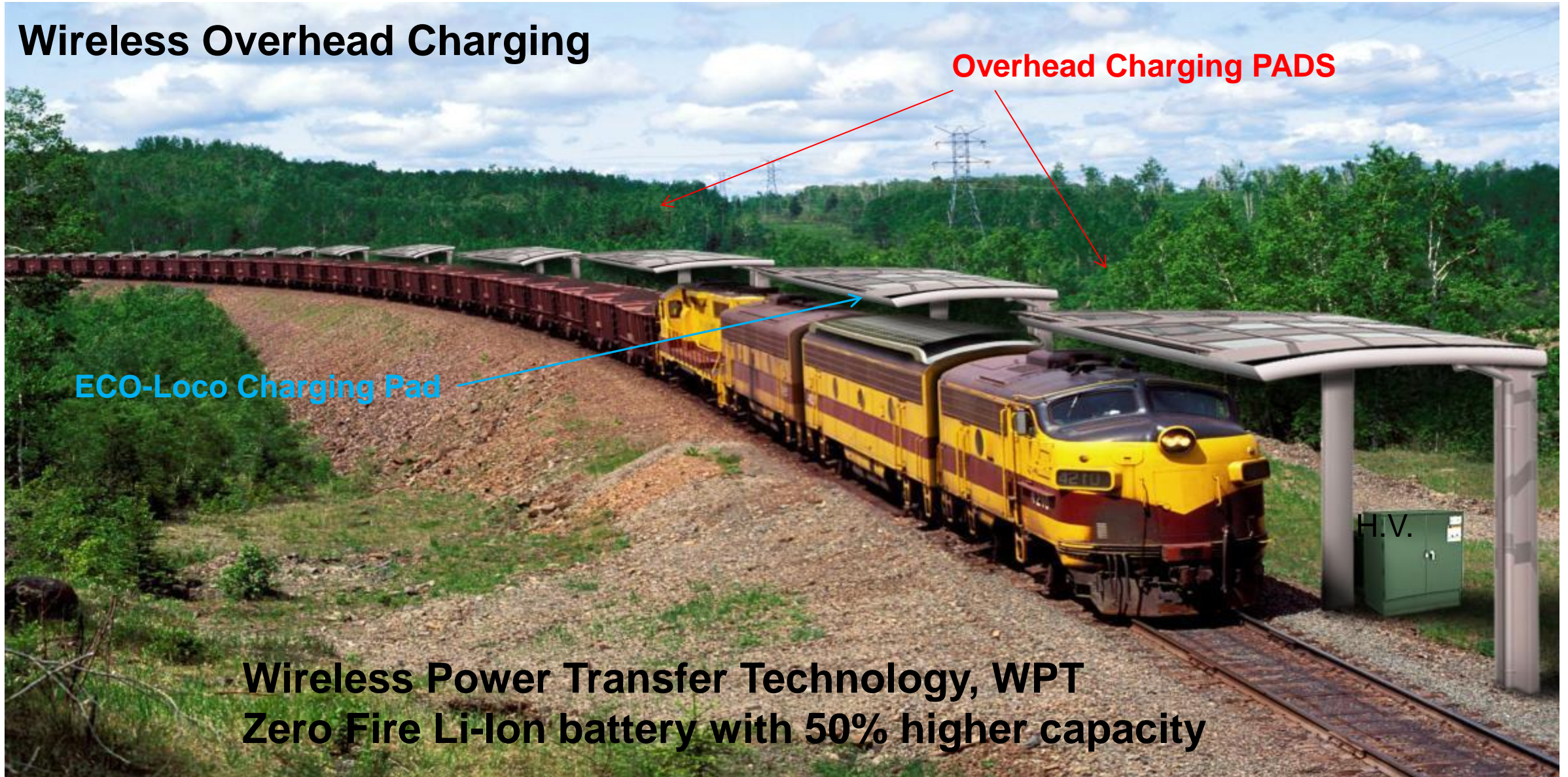


FIAT CHRYSLER AUTOMOBILES



Zero Emission Mile

Wireless Overhead Charging



Since 1987 has provided automotive industries with enabling powertrain control systems and strategies

Exhaust Emissions Compliance & Sign Off

Design, Fabrication, Testing, Aging,
Calibration, CARB, EPA Standards

Diesel Emissions Control Systems

SCR, DPF, FBC, NO_x Trap

Emissions & Fuel Economy Targets

Emissions Testing Labs
Chassis & Engine Dynos
FTRI, Customer Cycles

Control Software & Strategy

OBD Strategy and Software

Gasoline Diesel
EV, Hybrid, Fuel Cell

Electronics
Control Software

Alternative Fuels
CNG, LPG, Alcohol, Bio-Mass

Customized Electronics
Data Logging, Monitoring,
Integration

Hybrid Vehicle Control, Battery Charger

Power Plants, Generators, Marine Engine
Emissions Control Hardware / Software

Exhaust Emissions System Components for SCR and PM Control: ECU & Injectors



ServoTech Exhaust Electronic Controller

Analog Channels (6)

Such as:

- Temperature Sensors.
- Back Pressure Sensors.
- O2 Sensors.

Digital I/O Channels

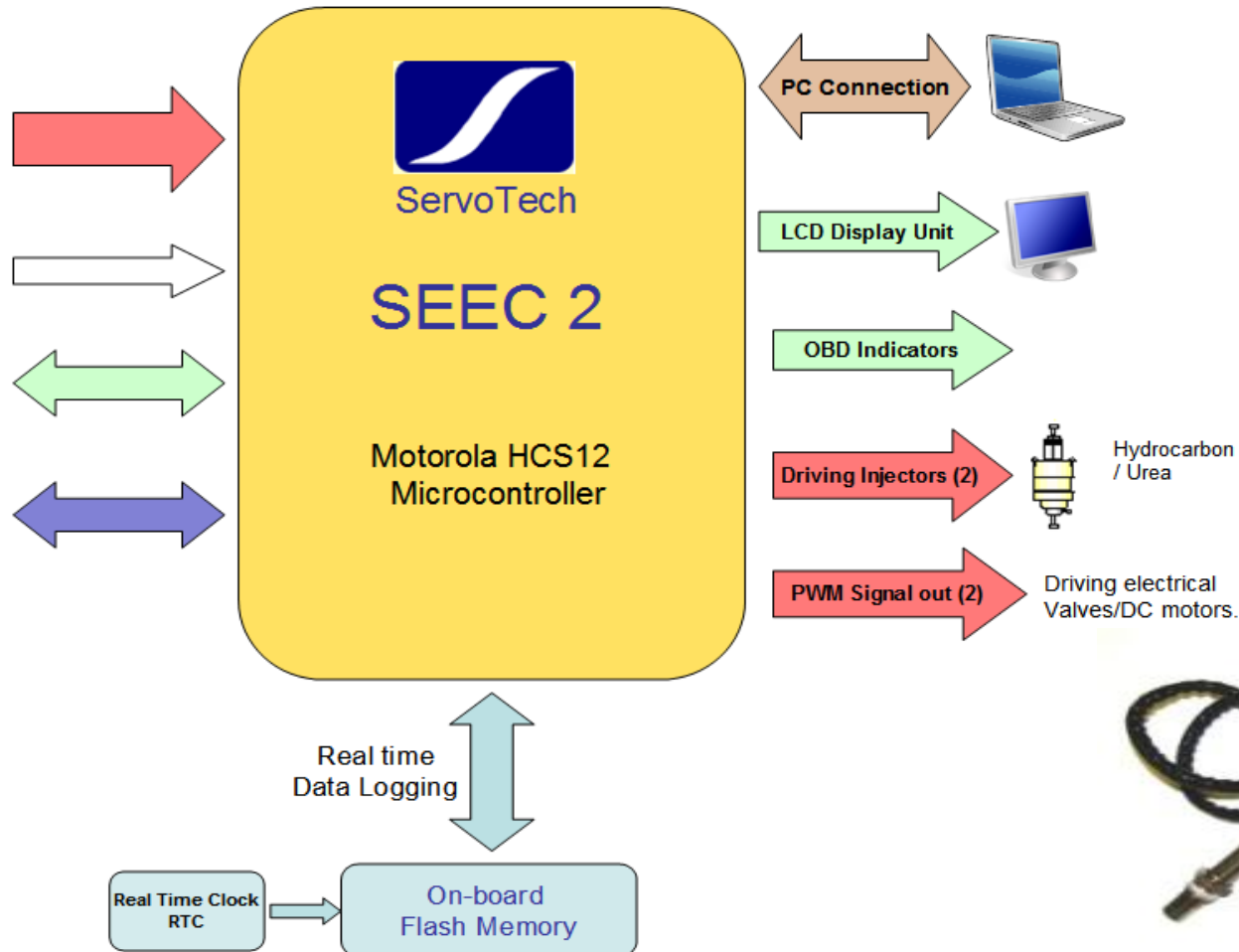
Additional RS232 port to communicate with auxiliary devices

CAN Channels (2)

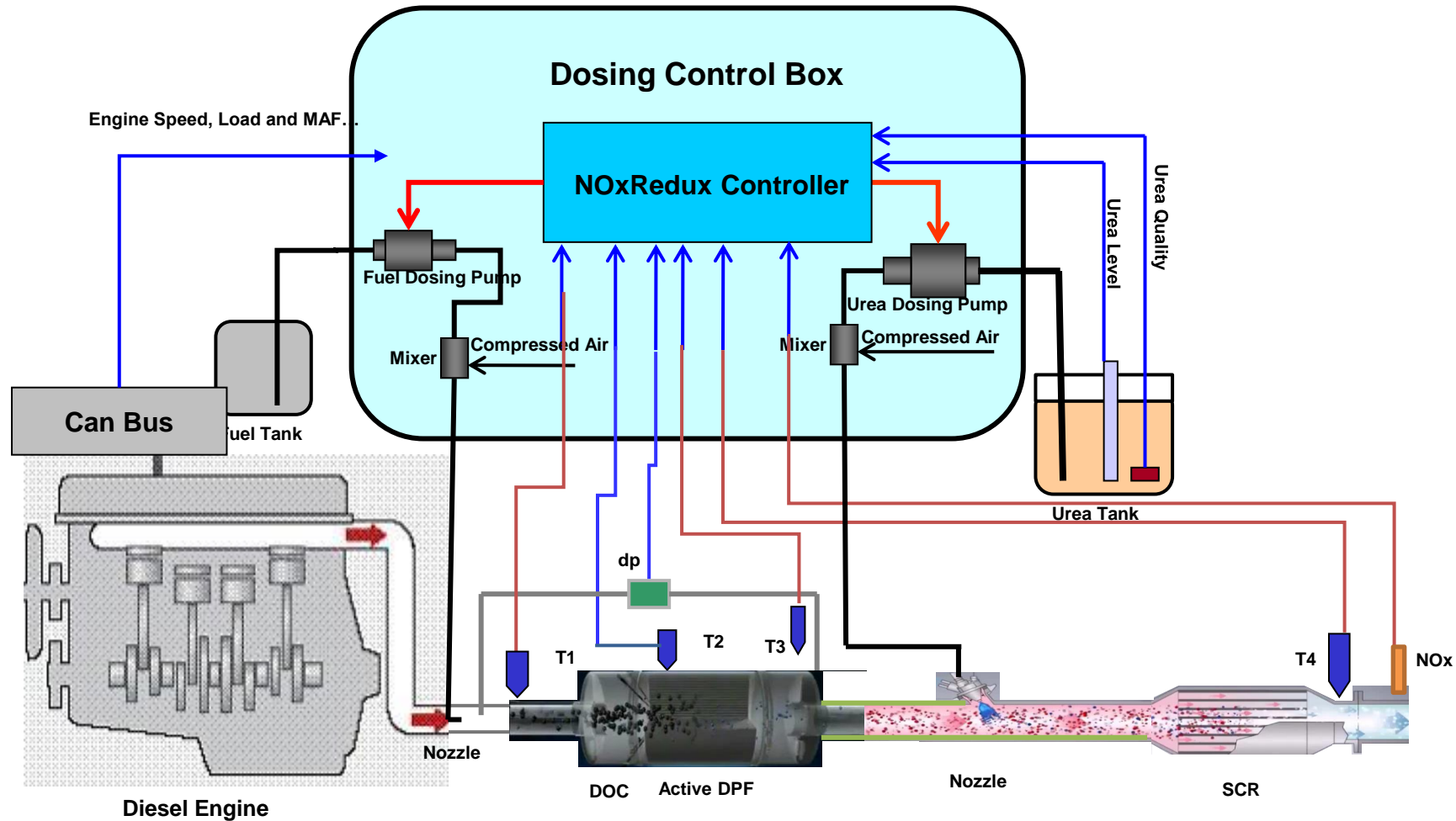
J1939 Compatible

CAN-enabled Sensors such as:

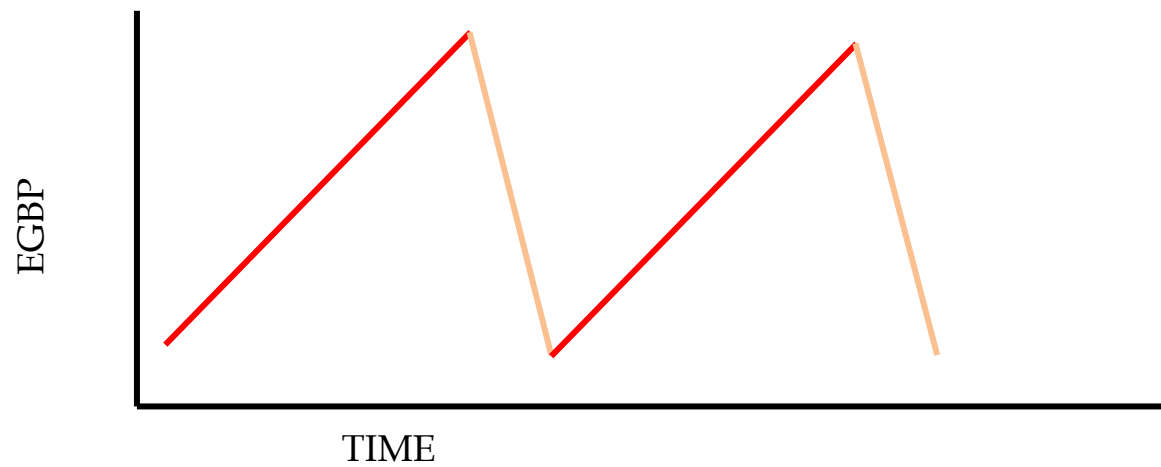
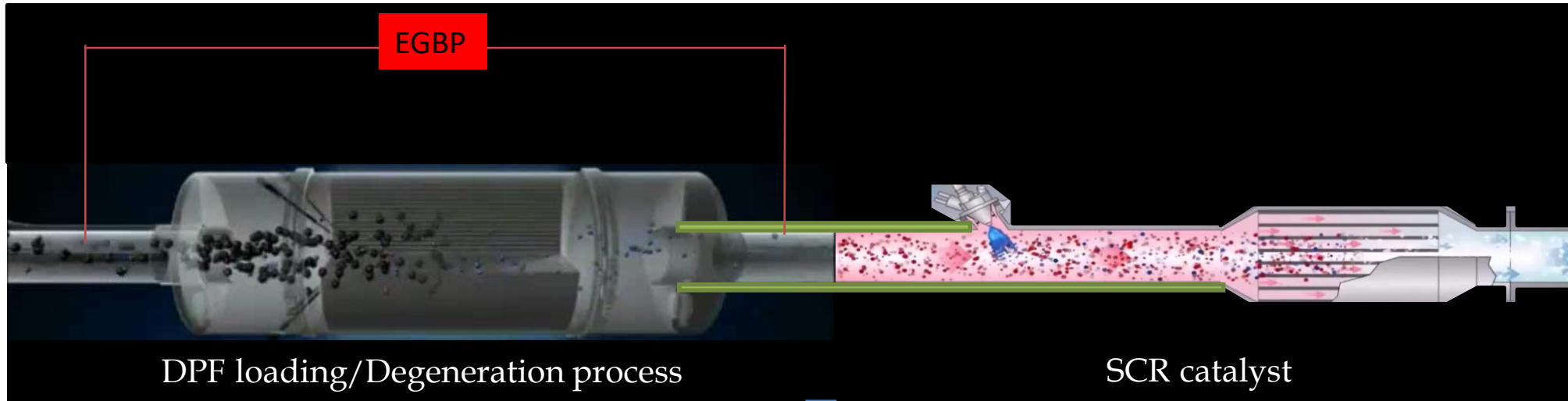
- NOx Sensors.
- O2 Sensors.



Active DPF and SCR Unit with Air Assisted Dosing

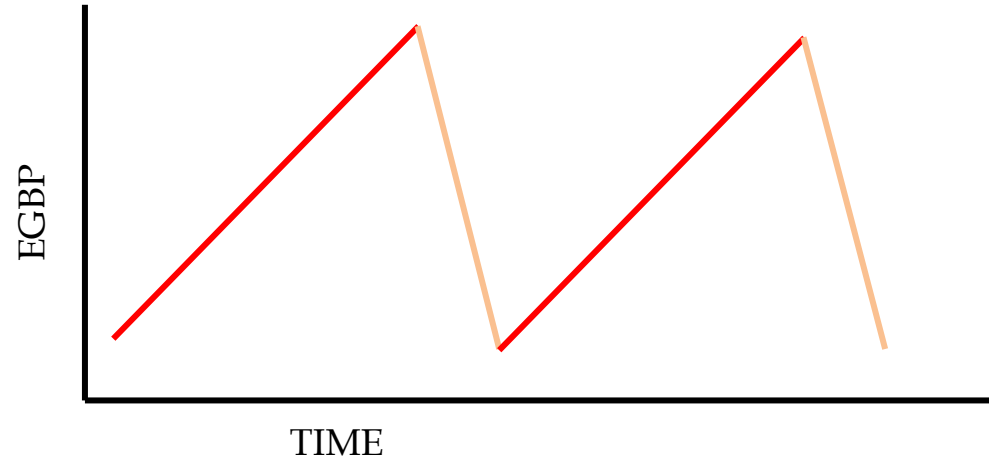
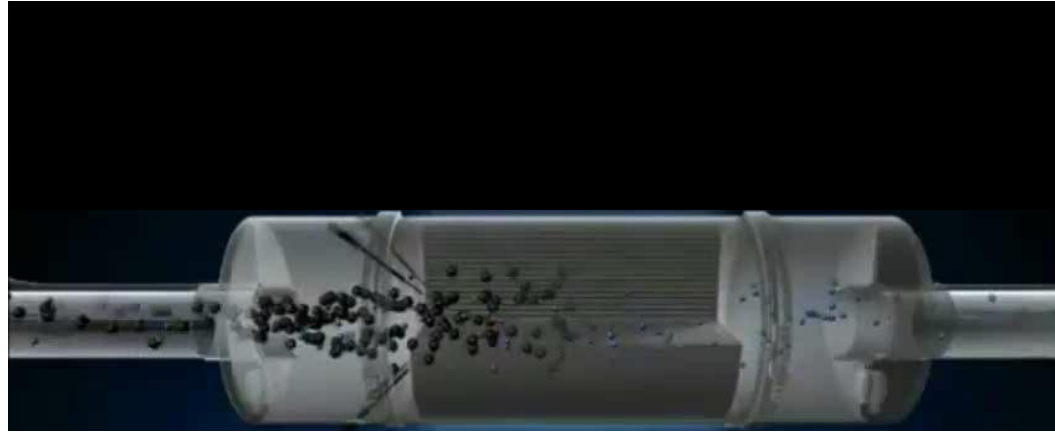


Combined DPF/SCR Retrofit System



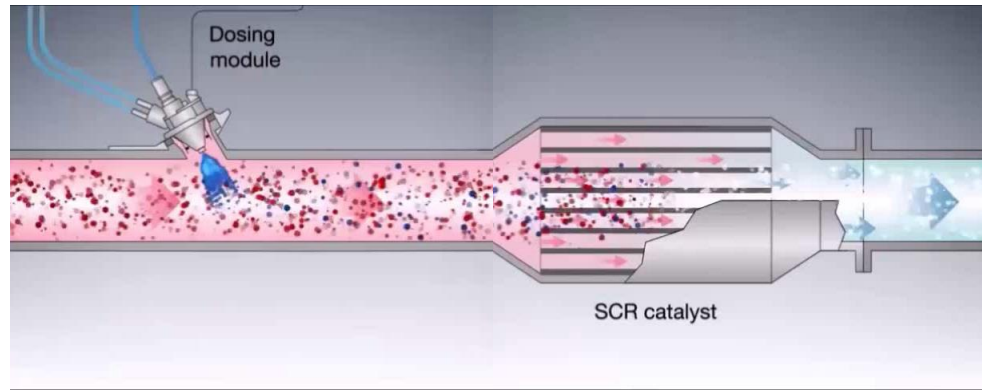
DPF Retrofit System

DPF Soot Loading / Regeneration Process



SCR Retrofit System

AdBlue / Urea Injection for SCR Retrofit System



Mobile Exhaust Emissions Control System

- 1- Introduction
- 2- Emissions Control Systems and Components
- 3- Powertrain Engineering
- 4- Background and OEM experience

**EXACT - EXHAUST AFTERTREATMENT COMPLIANCE
TECHNOLOGIES SIMULATION**

INPUT PARAMETERS

CONTROL STRATEGY

- PASSIVE
- CCC
- EHC
- EGI

ENGINE CHARACTERISTICS

- CONFIGURATION
- CALIBRATION

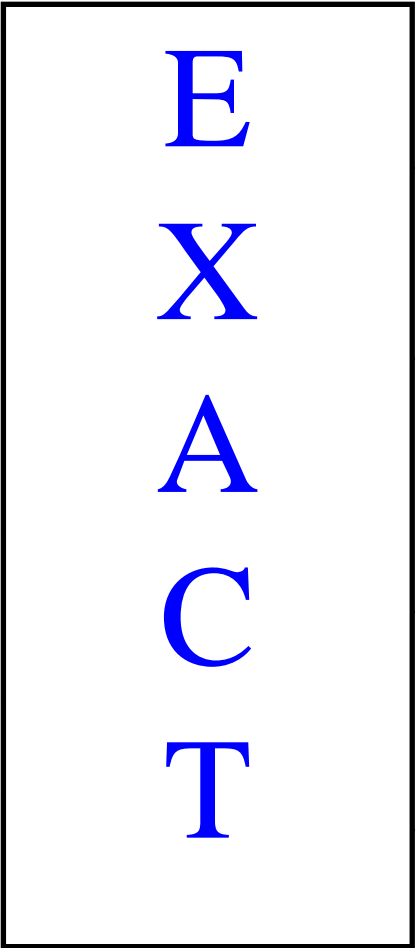
EXHAUST CONFIGURATION

- MANIFOLD
- TUBING
- CATALYSTS
- CCC, EHC, EGI,...

CATALYST CHARACTERISTICS

FEED GAS DATA SECOND BY SECOND

**EXHAUST PORT TEMPERATURE
PROFILE**



RESULTS

**TAILPIPE HYDROCARBON
EMISSIONS**

TEMPERATURE PROFILES

- SUBSTRATE
- EXHAUST GAS
- METAL

**EXHAUST
AFTERTREATMENT
RECOMMENDATION FOR
COMPLIANCE**

**CALIBRATION
RECOMMENDATION FOR
COMPLIANCE**

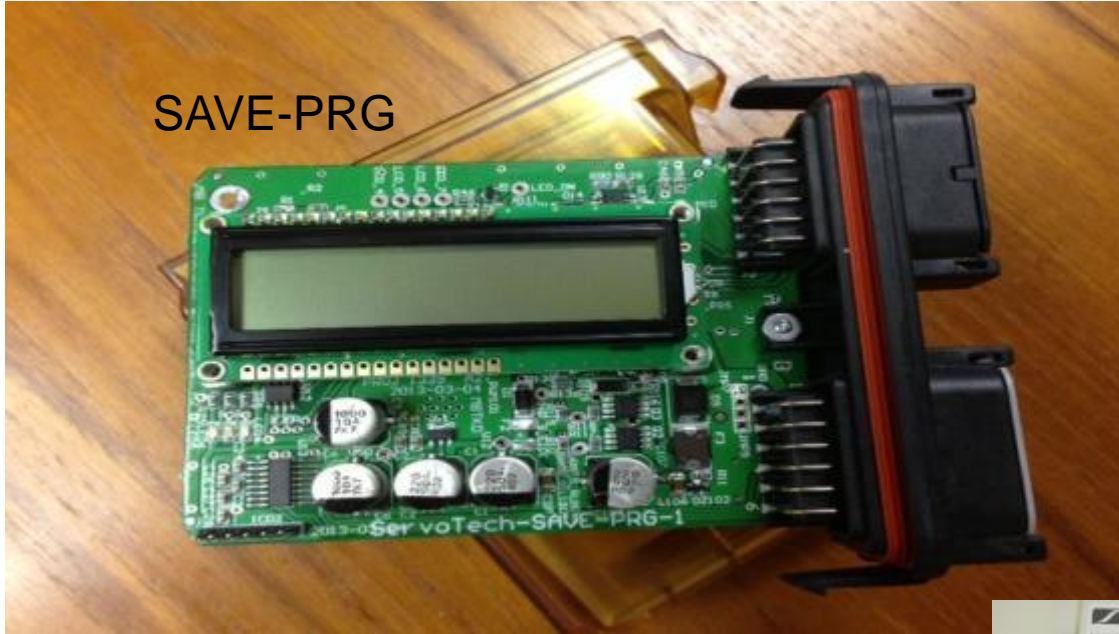
Stack and Exhaust Emissions Control Products

- Complete Turnkey Integrated SCR & DPF Systems
- Active & Passive DPF Catalyst System
- AdBlue / Urea Metering / Injector / Pump Delivery System
- ECU for Adblue / HC Dosing System Control



ECM Hardware and Software Products

SAVE-PRG



SEEC3



SEEC2



SOBRICAN



BP CONTROL

SEEC1



Injector & Pump Systems

-Excellent Linearity, Repeatability, Flow Integrity



Low-Cost Continuous Emissions Monitoring

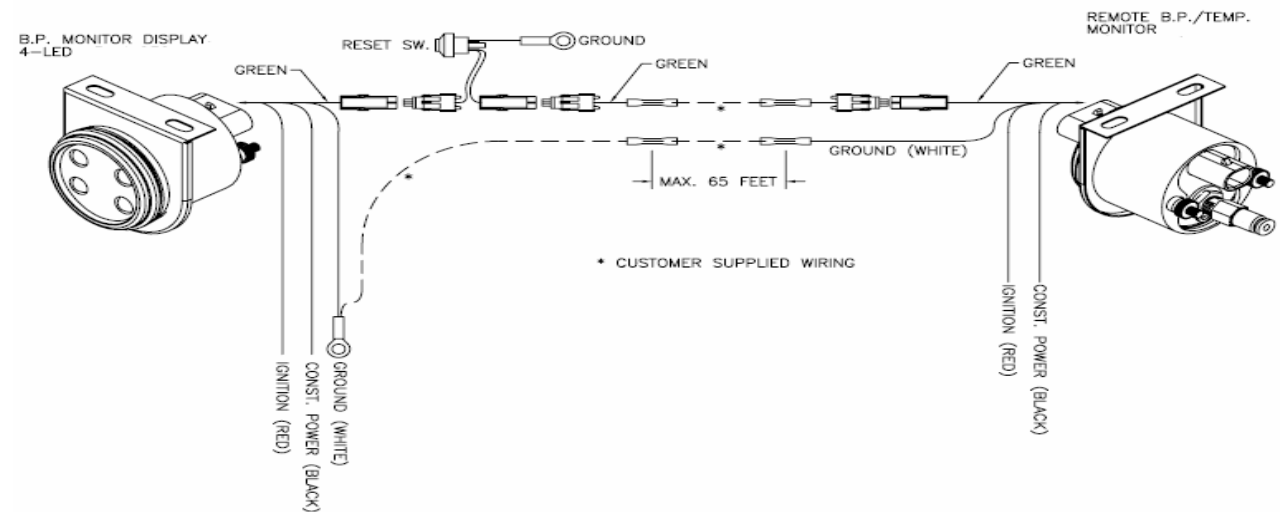
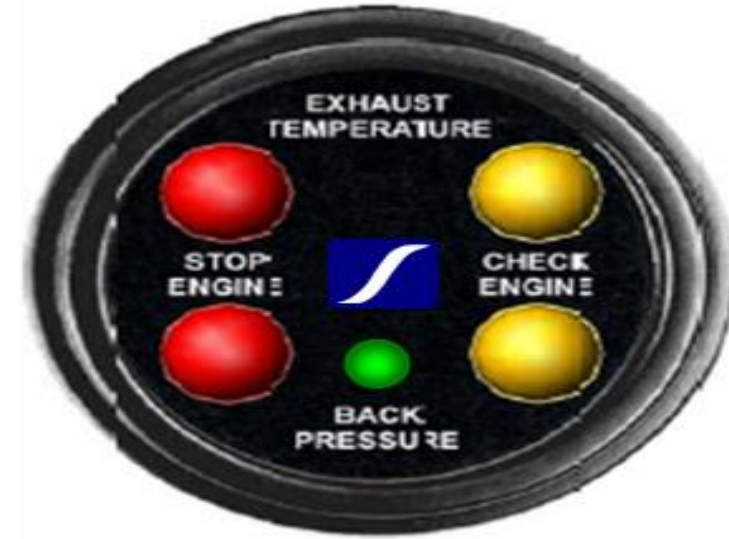


Features :

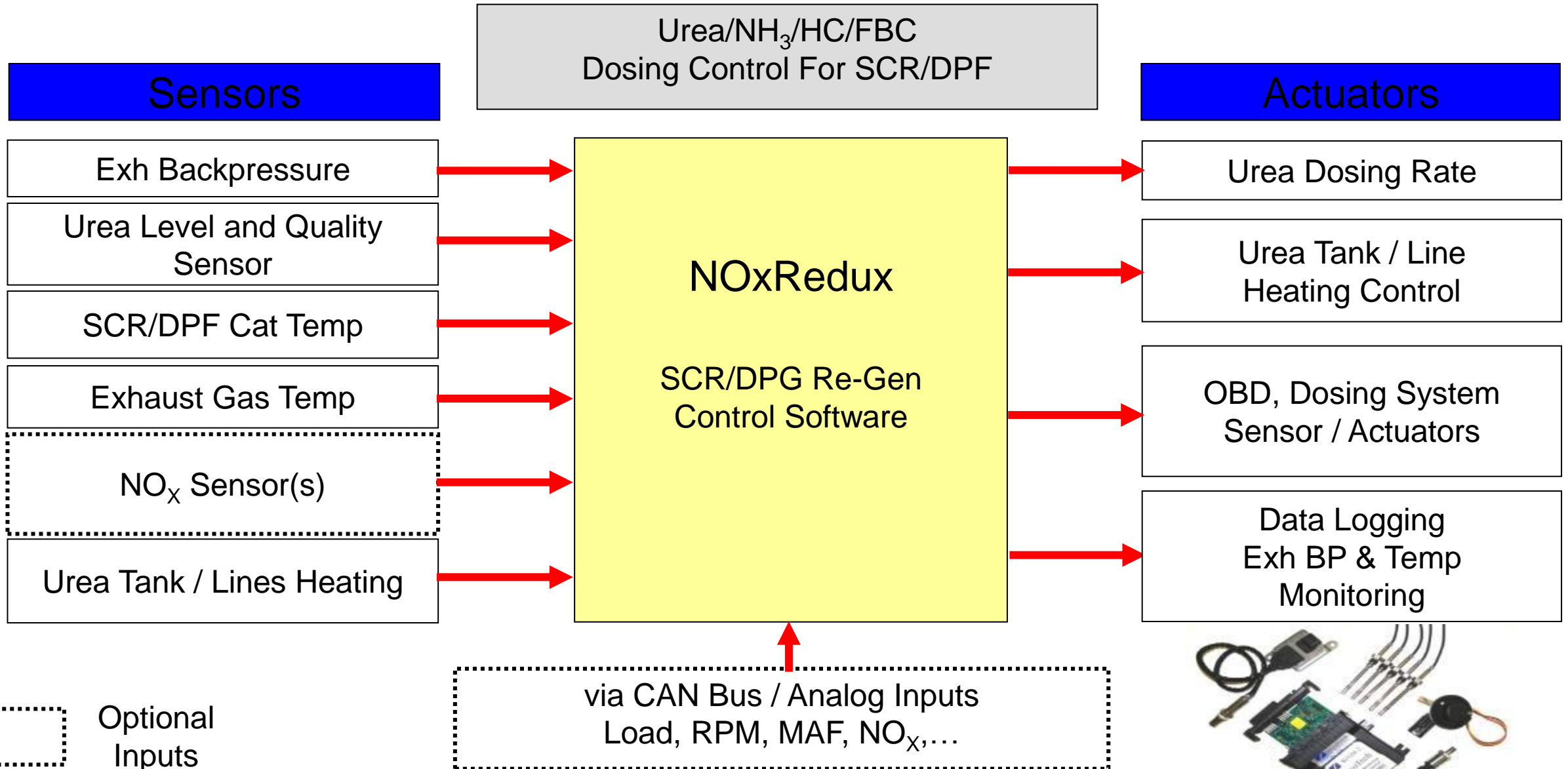
- Electronic control with real-time data logger
- Includes RTD temperature sensors
- Includes custom wiring harness
- Includes NO_x and exhaust backpressure sensors
- Log and download engine operating parameters
- System weight < 1.5 kg

S-ExAM-BP-T-5L BACK PRESSURE & TEMPERATURE MONITOR

- Monitors exhaust backpressure and temperature
- Indicates excessive pressure and temperature
- Two levels (Yellow and red light) pressure and temperature indicator lights (calibrateable)
- The lights remain lit once the pressure or temperature levels are reached until reset by maintenance person
- Shut the engine off (optional) when the “Red Light” comes on (perfect for unattended applications)
- Exhaust Pressure and Temperature selectable units
- Interface (serial port) for communicating with a PC
- PC software included
- Wireless serial port adapter (optional)



NOxRedux Exhaust Emissions Control



DeNOxer™ HMI Interface, Monitoring, Data Logging

DeNOxer

File COM Settings Terminal Connection Admin Tools Help

☐ Manual ☒ Auto Mode

Firmware 10102

Sensor Readings Look Up Tables Memory Data Logging DAC Quarterly Report Transfer Functions Relay Control Plot Data

[General Status](#)


Signal Name	Unit	Value
Nox_1	PPM	596
Engine NOx Load	g/s	0.655
O2_1	%	15
Nox_2	PPM	75
DeNOxer Load	g/s	0.082
O2_2	%	15
Nox Eff	%	87.4
Opt Urea	mL/m	0
Pump Flow	mL/m	0
Pre Burner Temperature, T1	F	428
Pre DOC Temperature, T2	F	359
Pre SCR Temperature, T3	F	316
Post SCR Temperature, T4	F	274
Burner PV	F	300
Engine Cumb Air	CFM	1000.0
NG Flow Rate	CFH	0
Urea Flow Rate	mL/m	0
Exhaust Gas Delta_p	In-H2o	0.0
Urea Pump Speed	RPM	0
Urea Pressure	PSI	300.0
Spare		0.0
Fuel Consumed	lb	0
Fuel Flow Rate	lb/hr	0
Engine Torque	lb ft	1000.0
Turbine Outlet Temperature	Dea F	0

Save Load

Read Data Set Complete Data Flash

Reading... System Working Disconnect Recording to Database ...

SERVOTECH SOBRICON-III-DEM Calibration Tool - Version 2.40
File Help Operation Mode


ServoTech

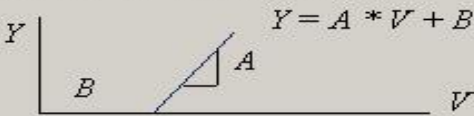
Output1.txt Browse Output File Name
0 Record Duration (Second) Record

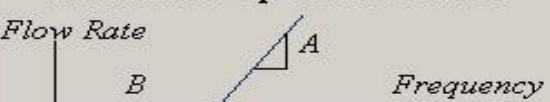
Injection Amount Required (g/min)

APP/RPM	700	1000	1200	1700	2000	2500	3000
0	0.5	0.5	0.8	1.1	1.3	3.23	4
15	1.2	1.3	1.21	1.42	2.6	4.2	6.67
30	1.02	1.43	2.96	3.1	1.9	2.2	5.7
45	2.3	3.65	4.53	4.32	4	4.8	6.95
60	2.3	1.73	3.02	3.75	9.9	11.65	16
75	2.3	2.5	4.03	5	11.6	13.22	15.43
90	2.3	2.55	3.44	9.34	12.37	17	14

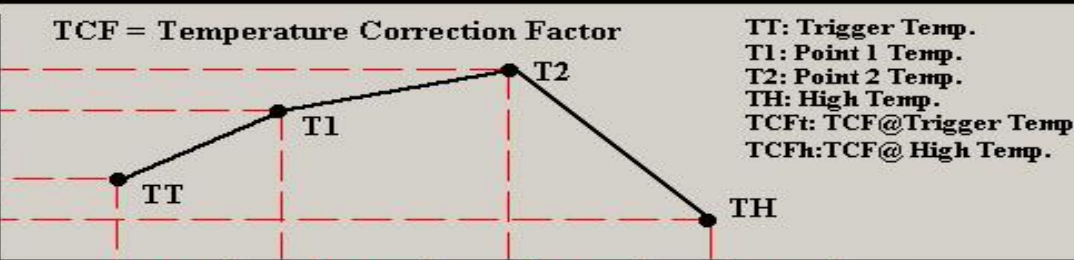
0 Injection Frequency (0-100 Hz)
3.2 Injection Pulse Width (2-60 ms)

Read Flash Data
Update Flash

Sensor Transfer Functions

 $Y = A * V + B$
RPM = 1200 * V2 + 0
APP = 20 * V1 + 0

SOBRIS Pump Characteristics

Flow Rate = A * Freq. + B
0.63 0

FLOW RATE Data
RPM Data
APP% Data
TEMPERATURE Data
TCF Data

TCF = Temperature Correction Factor
TCF2 1
TCF1 1
TCFt 0.5
TCFh 0.5

TT 180 T1 190 T2 350 TH 450 Temperature
TT: Trigger Temp.
T1: Point 1 Temp.
T2: Point 2 Temp.
TH: High Temp.
TCFt: TCF@Trigger Temp.
TCFh: TCF@High Temp.

1:24 PM 10/31/2005

Control System Process

System Parameters

Engine Data

Displacement, HP,...

Engine Operation

Air mass, RPM, Load, fuel burned, NOx Map
(model based, adaptive),
Exhaust Temp

Sensors

- Engine (turbo) Temp
- Pre DOC Temp
- Pre SCR NOx & Temp
- Post SCR NOx & Temp
- Mass air / Exhaust Flow
- Engine Sensor input via
CAN BUS (optional)

SCR Catalyst NOX

Performance Data

User Input Data

NOx TYP Requirement

Urea Dosing rate

Algorithms

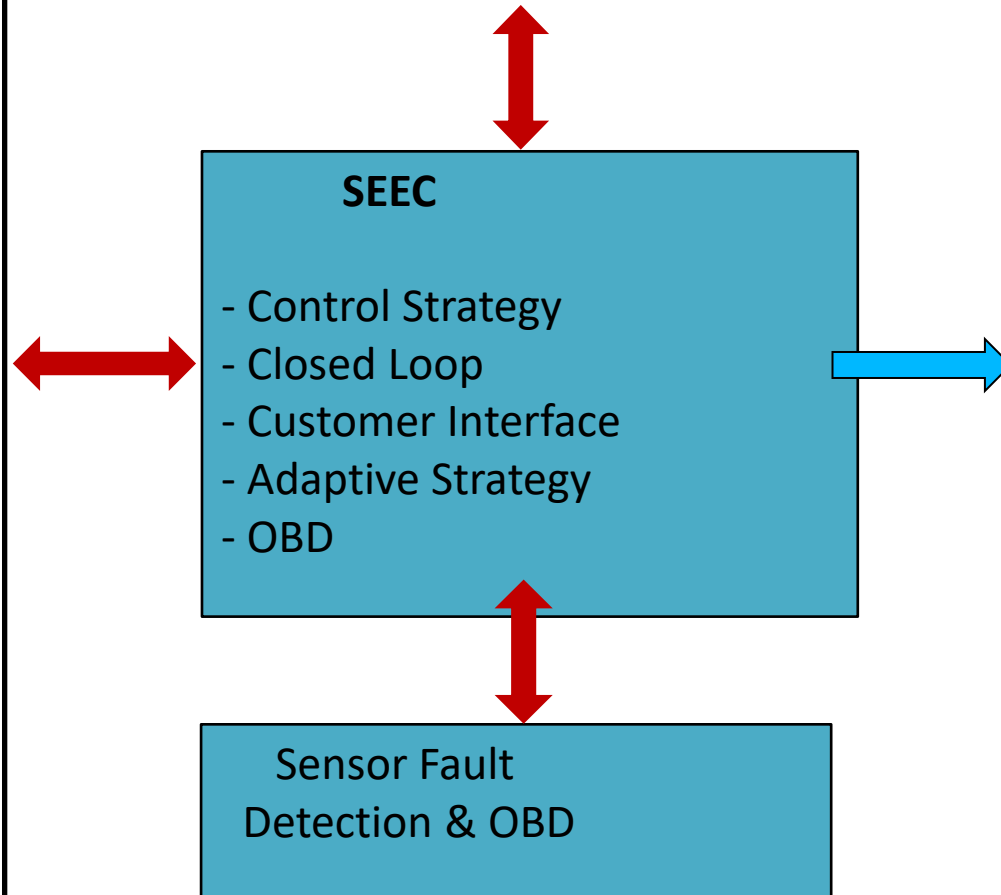
Statistical Analysis

SEEC

- Control Strategy
- Closed Loop
- Customer Interface
- Adaptive Strategy
- OBD

Sensor Fault
Detection & OBD

Report NOx Efficiency, OBD,
sensor values, urea usage, engine
operating parameters , remote
monitoring



ServoTech Embedded Electronic Controller – III (SEEC-III)

SEEC-III is an advanced controller capable of operating in automotive and other industrial harsh environment.

SEEC-III has 60 connector pins with inputs, outputs, CAN and RS232/USB communication interfaces.

SEEC-III uses dual high performance 32-bit PIC32MX embedded microcontrollers each with MIPS32 enhanced architecture, 512K Flash memory, 128K SRAM memory with a total of 1024K Flash memory, 256K SRAM memory together with real-time clock, 256K Serial EEPROM memory, 16Mbit Serial Flash memory and SD Card data acquisition capability.



SEEC III Exhaust Emissions Control

Capabilities and Features

10 to 16V power supply

Memory:
1MB Flash, 256K SRAM

Inputs:
Variable Reluctance and Digital Engine Position Sensor (crank and cam) Inputs, 12 Analog Inputs, 10 Digital Inputs or 10 Injector Read Inputs, and 1 System ON-OFF (key on) Input

Outputs
10 PMW
6 Analog
2 Extra Low Side Digital Outputs, 2 High Side Drivers and 2 H-Bridge

Communication Interfaces: 2 CAN buses and 1 RS232 Serial and 1USB Channel

Complete OBD functionality

Internal Function:
1 Main Power Relay, and 10 Switchable Injectors Relays

Microprocessor: 2 Microchip PIC32MX microcontrollers, maximum 80 MHz

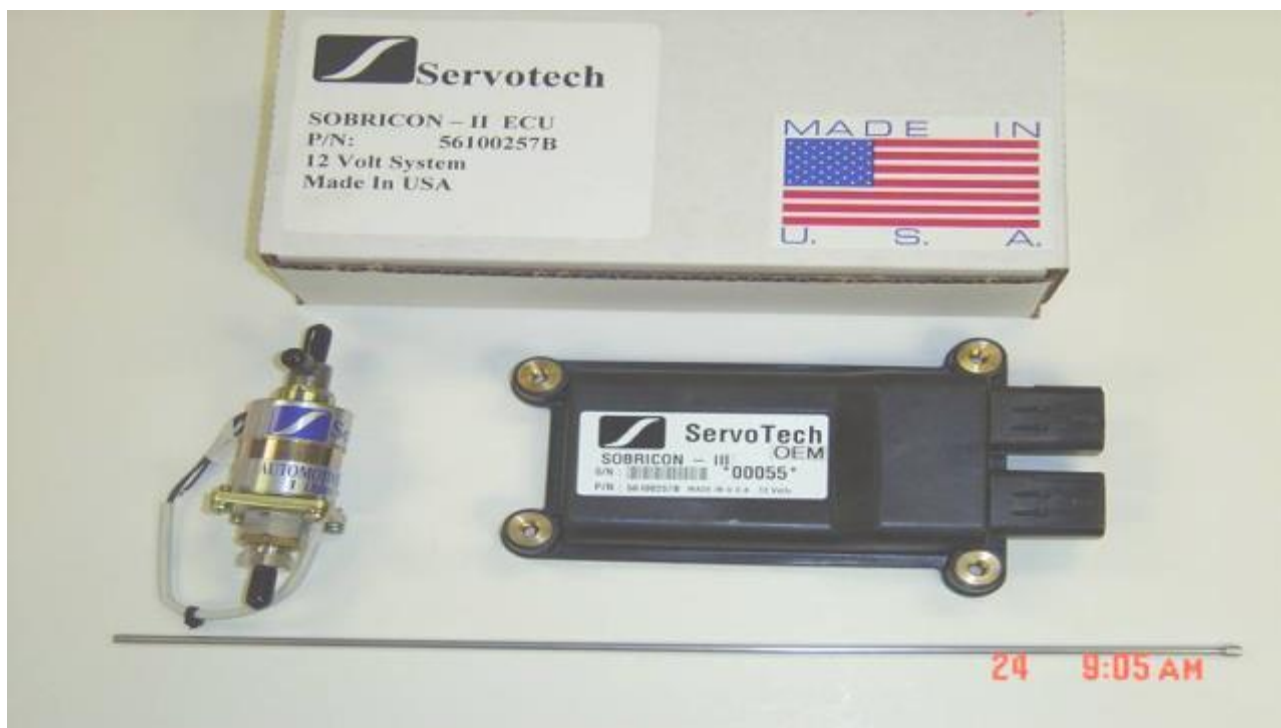
32 GB
On board Data Logging



Interfacing and Communications

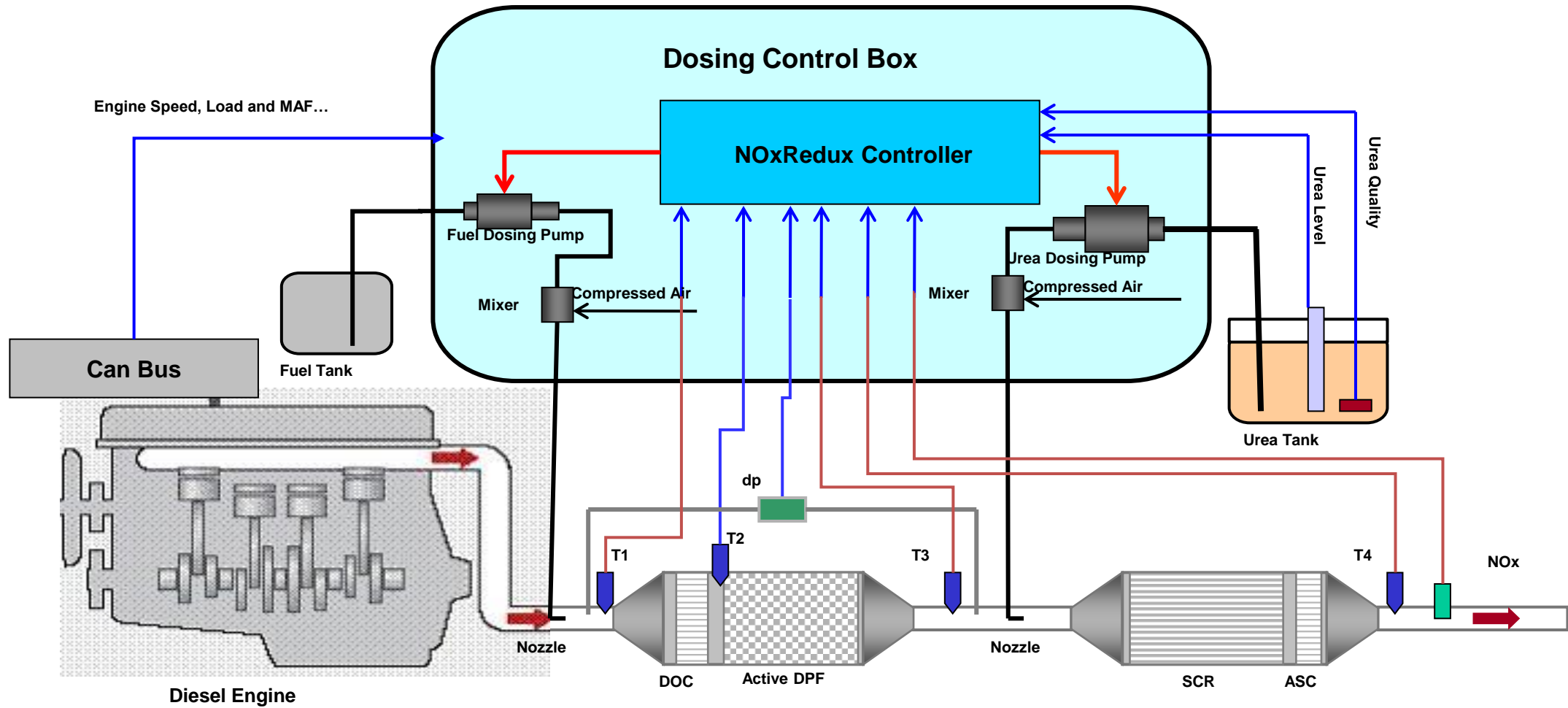


Electronic Control Units for Metering / Dosing Systems

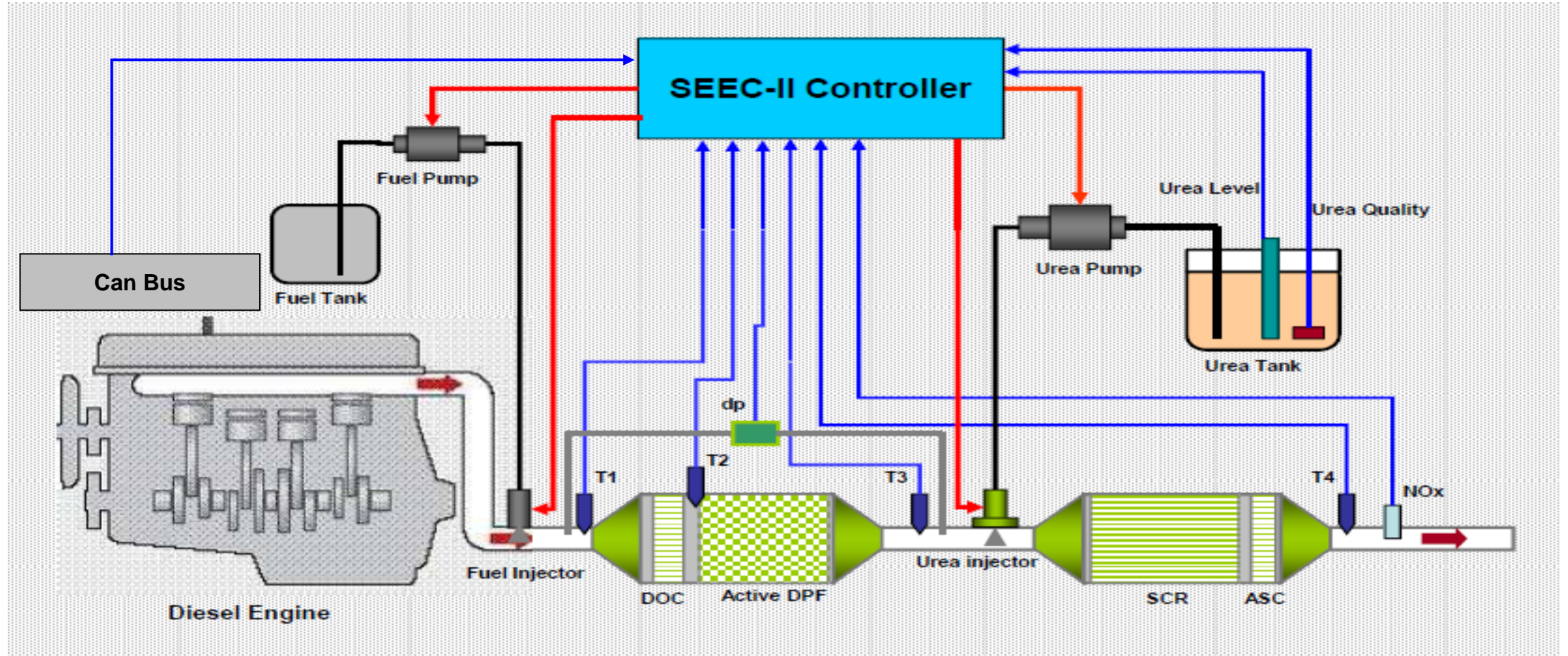


Combined DPF/SCR Retrofit System

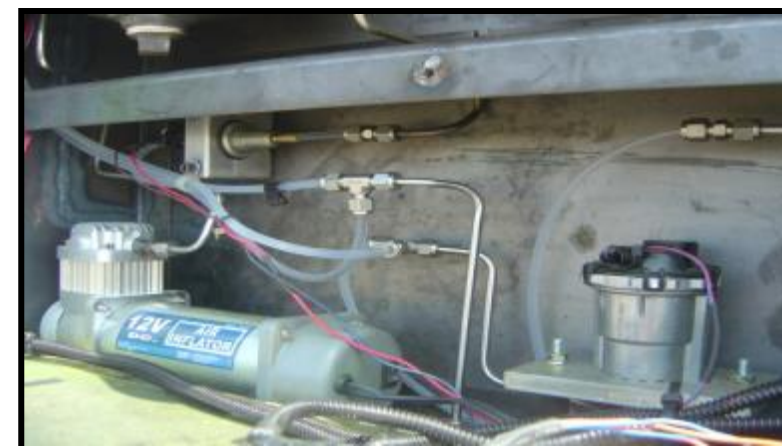
Active DPF and SCR Unit with Air Assisted Dosing



Airless Active DPF and SCR Dosing System



SCR /DPF Retrofit Examples



Powertrain and Emissions System Controls Background

ServoTech Engine Emissions Control Experience

and

Background for Gasoline and Diesel Application

Products & Services

Engineering

- Automotive Powertrain Engineering
- Control Electronics, Software, Calibration
- Exhaust Emissions Control System Development
- Emissions, Real World Durability, Vehicle Build
- Green Energy Technologies (EV, HEV)
- OEM & Aftermarket Systems
- Consulting & Technical Training

Manufacturing & Machining

- OEM & Aftermarket & Prototyping
- CNC MACHINING , TIG & MIG WELDING
- Tooling

Major Control Systems Development for OEM Projects

- **Engine & Exhaust Aftertreatment System Modeling & Software**
- **LEV / ULEV Program, First 1.9L ULEV
Demo Car On 1991(Ford Project)** [Including the Control Software]
- **Developed Enabling Technology For PZEV**
[Including the Control Software]
- **Calibration Automation & Control Strategies**
[includes Control Software for Air, Fuel, Transient Operations, cold starts]
- **Hybrid Electric Vehicle & Fuel Cell Technology**
[Complete Control Strategy and Software Development]
- **Cold Start Technologies & Control** [Including the Control Software]

- **Variable Displacement Engine (VDE)**
[Complete responsibility for electronics hardware and control software]
- **Calibrated Nearly All Ford Advanced Engineering Development Vehicles With Time/cost Efficiency From 1991 To 1996 utilizing**
[ServoTech developed calibration tools]
- **Developed Plasma Technology**
[Including the Control Software]
- **Lean Burn engine, Lean NOx Catalyst, Idle Robustness (Software)**
- **Real World Controlled Durability Testing**
- **Competitive Analysis / Customer Fuel Economy**
- **Powertrain Training / Concept / Design / Prototype / Test / Report**

- Diesel R & D, SCR & DPF Development / Testing

[Including Fuel, Mass Air, EGR, Turbo, Glow Plug, Exh Temp Software]

- Engine / Chassis Dyno Testing

- **Electronics & Software for new hardware in the loop**

- Fabrication & Vehicle Build

- OBD II, Warranty Analysis **[Including the Software]**

- Emissions & Calibration/Tools Training **[Including the Software]**

- Many Ex-ServoTech Employees Are Current OEM Employees

- The Most Time / Cost Efficient Company for Complex Tasks

Exhaust Emissions Control Licenses

-ON-BOARD REDUCTANT DELIVERY SYSTEM FOR DIESEL AFTERTREATMENT

US PATENT# 6,293,097, Ford Motor Company

LICENSED TO SERVOTECH ON 1/1/2002 (SOBRIS)

-Exhaust Gas Aftertreatment Systems:

US Patent 6,928,806 Ford Motor Company

License # 18004498

ServoTech/Ford NO_x Reduction Project

Municipal Utility Truck

City of Dearborn, Michigan USA

- SCR System with SOBRIS & SOBRICON
- Based On Dual Thermocouple Control Strategy
- DPF Included
- 75% NO_x Reduction Achieved

AUTOMOTIVE EMISSION CON
TECHNICAL CENTER
ServoTech Enginee

ZOATEX
510 SAVAGE ROAD

**CITY OF
DEARBORN**



 **ServoTech**
Engineering
1-800-SERV-LEV

365-02



F550

POWERSTROKE DIESEL V8

A photograph showing the underside of a yellow vehicle, likely a dump or salt truck, with its exhaust system components labeled. The vehicle is elevated on a lift in a workshop. The labels point to two Selective Catalytic Reduction (SCR) catalysts and a Diesel Particulate Filter (DPF).

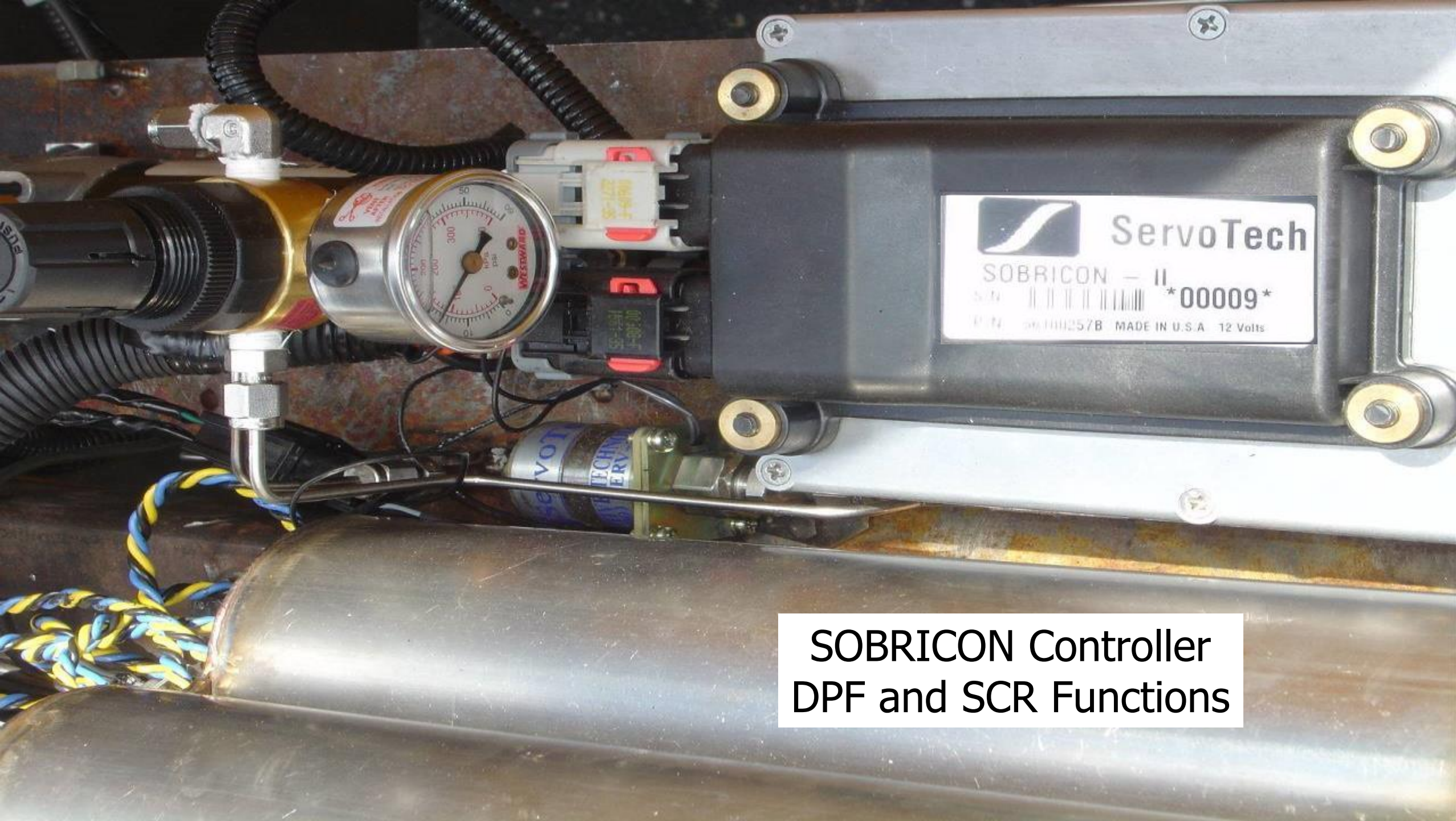
SCR₁

SCR₂

DPF

Application :
City Of Dearborn
Dump/Salt Truck

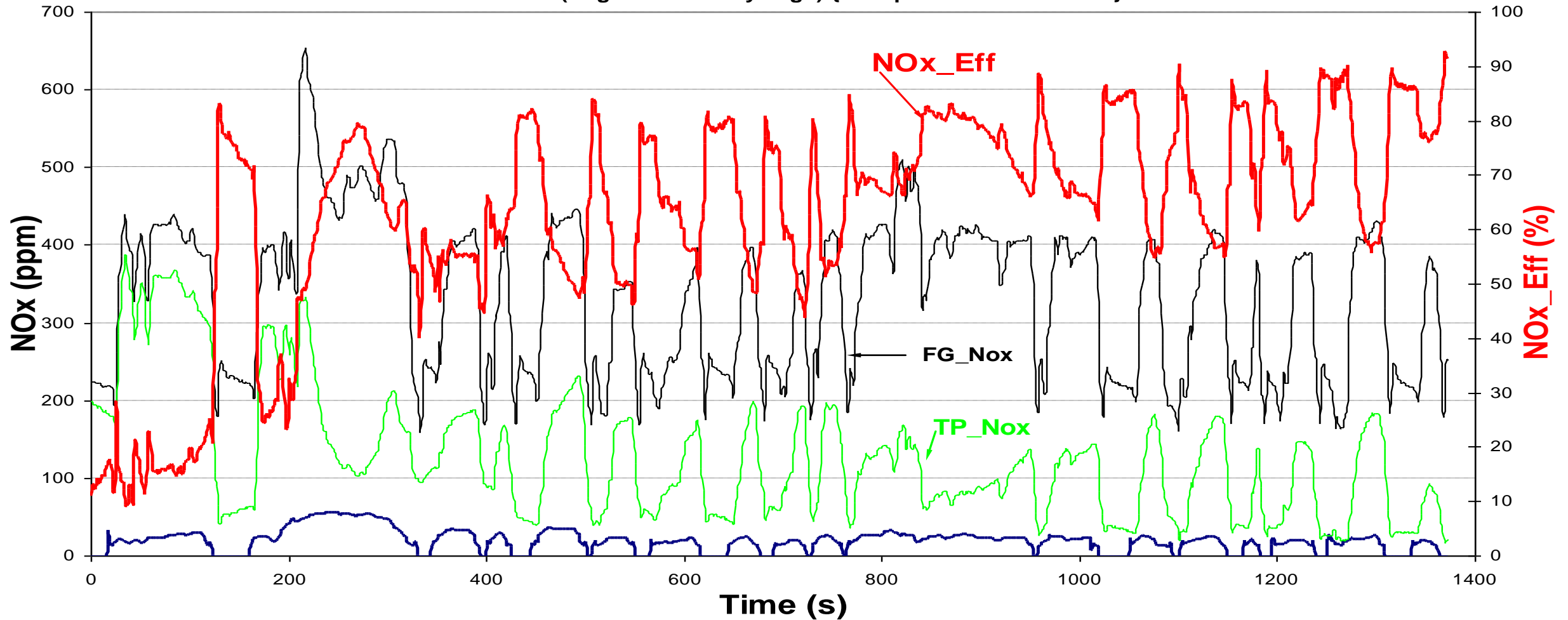
- DPF Catalyst
- Dual SCR Catalysts



SOBRICON Controller
DPF and SCR Functions

Dearborn Truck – FTP Test Results

City of Dearborn Dump / Salt Truck, 7.3L International
FTP TEST (Bag2 followed by bag3) {Un-Optimized Calibration}



DPF Soot Loading/Regeneration

