GM Powertrain Europe Engineering Center

Powertrain Electronic Control Units: development, models, analysis and tests according to General Motors

Alessandra Neri
Hardware Electrical Architecture Development Engineer

General Motors Company

THE WORLD'S BEST VEHICLES
GM vision and brands

General Motors Vision: Design, Build and Sell the World’s Best Vehicles
GM Powertrain 2005-2013

- GM 104 years-old
- GMPT/Torino 8 years-old
- Average age 35, 25% under 30
- 20% are women
GMPT-E Italy activities

Diesel Engine Engineering
- Diesel Engine design & testing
- Computer Aided Engineering (CAE) & Simulation
- Exhaust Aftertreatment
- Turbocharging

Controls Engineering
- Diesel Control (HW&SW)
- Engine Management System Components

GM is the only auto maker with complete software and systems expertise in control of Gasoline & Diesel engines and transmissions

Diesel Hybrid Engineering
- Engine system configuration modelling & optimization
- Diesel Hybrid verification

GLOBAL RESP IN TORINO
GMPT-E Italy Figures

- €30 million initial Investment
- 624 office places
- 15 Test Cells

- 12 Laboratories
- Workshops
- Chassis Dyno

50% of IP developed by GM Powertrain in Europe comes from Torino

€20 million new investment (2011-2014)
GMPT-E Italy Diesel Portfolio

- **2.5-2.8L**
  - Chevrolet Colorado

- **1.7L CDTI**
  - Opel Astra

- **2.0L CDTI**
  - Opel Insignia

- **1.0L CDTI**
  - Chevrolet Beat

- **2.2L CDTI**
  - Chevrolet Orlando

- **1.3L CDTI**
  - Opel Corsa

**Controller D1Plus:**

**New 1.6-liter diesel engine MDE**

General Motors Company

THE WORLD'S BEST VEHICLES
# Engine Control System Development

<table>
<thead>
<tr>
<th>Control System Architecture</th>
<th>Requirement Definition</th>
<th>Algorithm and Software Design</th>
<th>HW and SW test</th>
<th>Control System Validation</th>
</tr>
</thead>
</table>

**Controller D1Plus**
Diesel controls development

Our Teams

Electronic Engineering
- Electrical architecture and interface requirements
- Worst case and variation analysis
- Controller hardware engineering
- Target software build

Algorithm and software
- Model based approach
- Advanced signal processing and robust control
- Rapid prototyping
- Automatic code generation

Control system tools and testing
- HIL setup
- Tools development
- Test automations
- HIL testing
EURO5 typical architecture

1. Tank
2. Electric Fuel-feeding Pump
3. Fuel Filter Assembly
4. Damper Volume
5. High Pressure Pump
6. Fuel metering Valve
7. Rail
8. Rail Pressure Sensor
9. Solenoid Injectors
10. Air Filter
11. Air Flow Meter (+Air Temperature Sensor)
12. Compressor
13. Intercooler
14. Electronic Throttle Body
15. Electronic EGR Valve
16. EGR Cooler with pneumatic on/off by-pass valve
17. Intake Manifold Pressure + Temperature Sensor
18. Crankshaft Position Sensor
19. Camshaft Position Sensor
20. Coolant Temperature Sensor
21. Oil Minimum pressure switch
22. Oil Level Sensor switch
23. Metallic/Ceramic Low Voltage Glow Plugs
24. Variable Geometry Turbine
25. VGT Vacuum Modulator
26. VGT position feedback
27. Lambda Sensor
28. Main Cat
29. Diesel Particulate Filter
30. Temperature Sensor
31. DPF Relative to Ambient Pressure Sensor
32. Pedal Assembly
33. ECU
34. Electronic Variable swirl actuator
35. Temperature Sensor
36. Pre Cat
ECU System voltage/temperature ranges

- 26.5 Volt: 1 min max
- 18 Volt: 1 hour max
- 16 Volt: Full time
- 6 Volt
- 0 Volt
- -13.5 Volt

- Operating voltage range
- System voltage range
- Reverse battery voltage range

- Temperature range:
  - -105° to 0°