The Diesel Emission Control Group

DIESEL EMISSION CONTROL

MULTRONIC Emission Systems

DE-TRONIC
DIESEL EMISSION CONTROL
Activities of the Diesel Emission Control Group

**Diesel Emission Control Division (DEC)** is a designer and supplier of Diesel exhaust emission reduction control technology and systems for the **automotive on and off road market sectors**.

**Multronic Division (MTC)** is a designer and supplier of Diesel exhaust emission reduction control technology and systems for the **marine, rail and stationary engine market sectors**. **MTC** is also an official distributor for the KUS range of diesel and AdBlue sensing and gauging products for on and off road applications.

**The DE-Tronic** diesel dosing system for active DPF regeneration and urea dosing system for SCR are used by OEM and retrofit customers worldwide.

The Group has a small core of 30 key personnel and is supported by an international consortium of associates and partners, world leaders in their respective fields. Production is outsourced.
locations

- **Toronto, Canada**
  - Sales office

- **Chongqing, China**
  - Sales and technical support office

- **Rotterdam, Netherlands**
  - Engineering, Project management and technical support office
  - Facility for technology development, engineering, development, and validation
  - System testing
  - Service and support marine operations

- **London, UK**
  - Administration office handling the commercial activities of the company

- **Tienen, Belgium**
  - Facility for technology development, engineering, development, and validation

- **Cherasco, Italy**
  - Software development and production

- **Scandinavia**
  - Sales offices Bergen and Göteborg

- **UHerske Hradište, Czech Republic**
  - Engineering, Project management and technical support office
Fields of Application
2001 **DE-Tronic** ECU system development started for in-house applications

2005 An industrialization agreement for software development and hardware production was signed with **Fuel System Solutions/BRC** in Cherasco, Italy

2007 OES agreement signed with **Scania Benelux** for all DPF SYSTEMS EURO III=> EURO V for PM

2010 Licensing agreement with **TU Graz** for their SCR dosing technology

2011 Licensing agreement with **CDTI** for their **airless urea injection technology**

2012 OEM agreement signed with **ZETOR Tractors** for **Stage IV** and **TIER 4F** for **turn key** solution

2013 OEM agreement signed with **YAMZ** for **Euro V turn key** solution

2014 OEM agreement signed with **LIAZ/MAZ/URALAZ/YAMZ** for **EURO V turn key** solution

2014 Agreement signed with **European Commission** and **TNO/TUV** to develop **OBD MARINE** standard for marine **Stage V**

2016 Supply to **ZETOR Tractors** of the Stage IV system begins

2016 Supply to **LIAZ, MAZ, URALAZ, KRAZ** begins

2017 **DE-Tronic & DEC technology selected** for SCR control for different powerplants throughout the U.K

2017 OEM agreement signed with **Sokon Donfeng** for **China 5** DPF active regeneration management DCU

2017 OEM agreement signed with **major Indian OEM** for BS6 program
The following important licences are held by DEC:

- DEC has been granted worldwide licences to practice the following methods for **airless urea injection**:
  
  - Patent 5,976,475 (and worldwide equivalents); Return flow injection system for urea using reagent for injector cooling.
  - U.S. Patent 6,063,350 (and worldwide equivalents); Method to operate and control the return flow system.
  - U.S. Patent 6,279,603 (and worldwide equivalents); Fluid cooled injector

- An exclusive worldwide licence from The Institute of Internal Combustion Engines and Thermodynamics, Graz for their SCR dosing and control strategies.
With the functionalities of DE-Tronic all diesel engines can be compliant with EURO IV/ V / VI, Stages III/IV/V, TIER 3/4i/4F

<table>
<thead>
<tr>
<th>PM reduction &gt; 95%</th>
<th>NOX reduction &gt;95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPF Monitoring</td>
<td>EGR Control</td>
</tr>
<tr>
<td>DPF Active regeneration</td>
<td>SCR control</td>
</tr>
<tr>
<td>DH CPI (Diesel Hydrocarbon Post Injection)</td>
<td>Urea Dosing</td>
</tr>
<tr>
<td>E-Heaters</td>
<td>Ammonia Dosing</td>
</tr>
<tr>
<td>Throttle valve*</td>
<td>Tank/line Pump heating</td>
</tr>
</tbody>
</table>
DE-Tronic additional features

**OBD**
- DM1 – DM4 diagnostics
- Data logging
- Dash board communication
- J1939 CANbus network
- Component integrity

**PC interface**
- 15 standard access level
- 254 available
- Preprogrammed default universal settings
- Telemetry
- Graphic data analysis
Possible to use in combination with mechanical and common rail diesel engines

Durability

Competitive

Application specific

Flexible

Competitive development fee
Example of an electronic layout

Diesel E-gas system or CR

- TIN
- Temp coolant
- MAP
- Measured actuator position of pump
- ACT SENS
- RPM
- Torque according to J1939 standard
- Fuel rate
- Pedal Position

DASHBOARD
- Engine pre heating – glow plugs
- Transmission / Gear Box

CANBus 0 J1939
- Intra CANbus
- PUBLIC CANbus

Analogue

OBD connector

Urea pump Driver

NOX Table

- Urea Press
- Urea level
- Urea temp
- Urea inject.
- Urea heating
- Air intake throttle valve
- Power relay
- Vap. Relay or HC pump
- Diesel metering or injector
- EGR VALVE

DIESEL EMISSION CONTROL GROUP
DEC has supplied its DE-Tronic diesel dosing system for DPF active regeneration and its urea dosing system for SCR to numerous system integrators worldwide:

- **Belgium** ..... Bus fleet Brussels
- **China** ..... Bus, gensets
- **Germany** ..... Truck
- **Holland** ..... Bus and truck fleets
- **Italy** ..... Gensets
- **Hong Kong** ..... Kowloon bus fleet
- **U.K.** ..... Bus fleets London, Manchester, Liverpool etc
- **USA, California** ..... Truck operators
- **USA, Chicago** ..... Chicago Transit Authority school bus fleet
- **U.K.** ..... Powerplants throughout the country
Current OEM Programs

- **Czech Republic ..... Zetor Tractors,**
  Development and supply of Stage IV/Tier 4F aftertreatment technology (DPF + SCR)

- **Belarus ..... Minsk Engine Works (MMZ)**
  Development of Stage V aftertreatment technology (DPF + SCR)

- **Belarus ..... Maz Trucks**
  Implementation of Euro V aftertreatment technology (SCR)

- **Russia ..... Liaz Bus**
  Implementation of Euro V aftertreatment technology (SCR)

- **Russia ..... Uralaz**
  Implementation of Euro V aftertreatment technology (SCR)

- **Russia ..... Yaroslavl Motor Works (YaMZ)**
  Development of Euro V aftertreatment technology (SCR)

- **China ..... Sokon/Dongfeng**
  Development of China 5/6 aftertreatment technology (SCR)

- **India ..... Ashok Leyland**
  Development of BS6 aftertreatment technology (DPF + SCR)
Stage IV / V & Tier 4 Final Technology
### Engine Description

<table>
<thead>
<tr>
<th>Engine Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine type</td>
</tr>
<tr>
<td>Engine displacement [L]</td>
</tr>
<tr>
<td>Power rate [kW]</td>
</tr>
<tr>
<td>NOx Engine out [g/kWh]</td>
</tr>
<tr>
<td>PM Engine out [g/kWh]</td>
</tr>
<tr>
<td>PN Engine out [g/kWh]</td>
</tr>
</tbody>
</table>

### Requirements

<table>
<thead>
<tr>
<th>Requirements</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NOx Reduction</td>
<td>96 %</td>
</tr>
<tr>
<td>PM Reduction</td>
<td>95%</td>
</tr>
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</table>
### DOC/DPF Volume [L]

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<table>
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<tbody>
<tr>
<td>DOC</td>
<td>3,113</td>
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<tr>
<td>DPF</td>
<td>6,255</td>
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### Emissions

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<table>
<thead>
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<tbody>
<tr>
<td>PM [g/kWh]</td>
<td>0.002</td>
</tr>
<tr>
<td>PN [#/kWh]</td>
<td>3,315e10</td>
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### Compliancy

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Stage IV</td>
<td>Yes</td>
</tr>
<tr>
<td>Tier 4F</td>
<td>Yes</td>
</tr>
<tr>
<td>Stage V</td>
<td>Yes</td>
</tr>
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</table>
### SCR/ASC Volume [L]

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td>SCR</td>
<td>12.3</td>
</tr>
<tr>
<td>ASC</td>
<td>2.9</td>
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### Emissions

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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>NOx [g/kWh]</td>
<td>0.26</td>
</tr>
<tr>
<td>NH3 [ppm]</td>
<td>&lt;7</td>
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</table>

### Compliancy

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<table>
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<tbody>
<tr>
<td>Stage IV</td>
<td>Yes</td>
</tr>
<tr>
<td>Tier 4F</td>
<td>Yes</td>
</tr>
<tr>
<td>Stage V</td>
<td>Yes</td>
</tr>
</tbody>
</table>
NOx reduction in the NRSC:

![NOx Engine Out Vs NOx Tail Pipe graph]

- **NOx1**
- **NOx2**

Mode [%]
Euro VI & Bharat stage VI Technology
### Engine Description

<table>
<thead>
<tr>
<th>Engine type</th>
<th>6 cylinder Diesel engine with mechanical inline fuel pump (DI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine displacement [L]</td>
<td>5.7</td>
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<tr>
<td>Power rate [kW]</td>
<td>148</td>
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<tr>
<td>NOx Engine out [g/kWh]</td>
<td>6.5</td>
</tr>
<tr>
<td>PM Engine out [g/kWh]</td>
<td>0.1</td>
</tr>
<tr>
<td>PN Engine out [g/kWh]</td>
<td>Not available</td>
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### Requirements

<table>
<thead>
<tr>
<th>NOx Reduction</th>
<th>95%</th>
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<tbody>
<tr>
<td>PM Reduction</td>
<td>94%</td>
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</tbody>
</table>
WHTC cold NOx Reduction and NH3

[Graph showing NOx and NH3 levels over time with different lines representing various parameters such as NOx1, NOx2, NH3 concentration, and TempT4.]
WHTC Hot NOx Reduction and NH3

WHTC Hot - NOx and NH3

Time [sec]

NOx [ppm] NH3 [ppm]

Temp. SCR Out [degC]

NOx1 [ppm] - EGR
NOx2 [ppm] - EGR
NH3Conc [ppm] - EGR
TempT4 [°C] - EGR
<table>
<thead>
<tr>
<th></th>
<th>WHTC</th>
<th></th>
<th>WHSC</th>
<th></th>
<th>NTE</th>
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<tbody>
<tr>
<td></td>
<td>Limit</td>
<td>Cycle Emissions</td>
<td>Limit</td>
<td>Cycle Emissions</td>
<td>Limit</td>
<td>Cycle Emissions</td>
</tr>
<tr>
<td>Nox [mg/kWh]</td>
<td>460</td>
<td>295</td>
<td>400</td>
<td>140</td>
<td>600</td>
<td>291</td>
</tr>
<tr>
<td>NH3 [ppm]</td>
<td>10</td>
<td>2.8</td>
<td>10</td>
<td>6.5</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>PM [mg/kWh]</td>
<td>10</td>
<td>2.9</td>
<td>10</td>
<td>1.8</td>
<td>16</td>
<td>2.1</td>
</tr>
<tr>
<td>Name</td>
<td>Low speed</td>
<td>Medium Speed</td>
<td>High Speed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------</td>
<td>---------------</td>
<td>--------------</td>
<td>------------</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Displacement (l/cyl)</td>
<td>200 - 2000</td>
<td>16-120</td>
<td>0.8 - 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power range (kW)</td>
<td>4000 – 100000</td>
<td>800 - 40000 kW</td>
<td>Up to 800 kW</td>
<td>Up to 300 kW</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combustion type</td>
<td>2-stroke &amp; 4 stroke</td>
<td>2-stroke &amp; 4 stroke</td>
<td>4 stroke</td>
<td>4 stroke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotation speed (rpm)</td>
<td>70-300</td>
<td>350 - 850</td>
<td>600 - 3000</td>
<td>&gt;3000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Marine retrofit programs

Barge
Engine: Scania V8 16 liter 450 kW

Police Patrol ship
Engine: 2 x MTU V2000-01 600 kW
1 x Caterpillar 3516
1590 kW - SCR and DPF

2 x Caterpillar 3512
1130 kW - SCR
Genset installation: China
Thank you for your attention