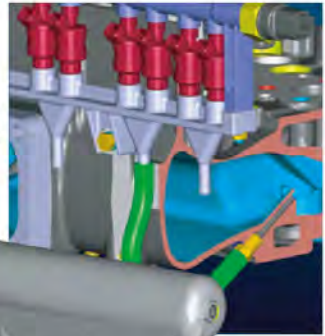


## Engineering Capability

Metatron provides not only EMS product, but also engineering support on engine design and performance development, as below.

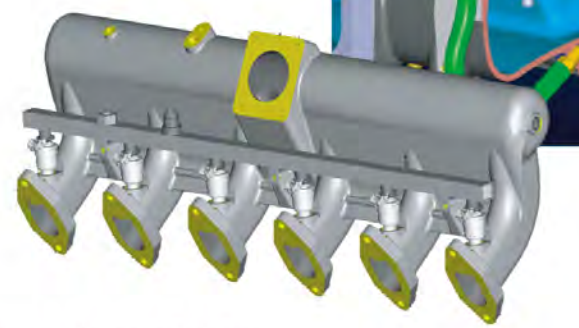
### For engine:

- Intake manifold and natural gas injection system design
- CAM phasing and valve train optimization
- Metallurgy for stoichiometric engines (valves and valve seats, exhaust) and optimization of cylinder head cooling circuit
- Turbocharger fitting for full stoichiometric or combined lean-mix combustions



### For EMS:

- Engine and vehicle calibration
- Control strategy development for both emission and performance
- Full EOBD capacity: integrated strategy and calibration procedure



### Others:

- The Independent Vehicle Control Module (VCM), to meet the application gap for special and complex vehicle functions between EMS and vehicle (bus or truck)

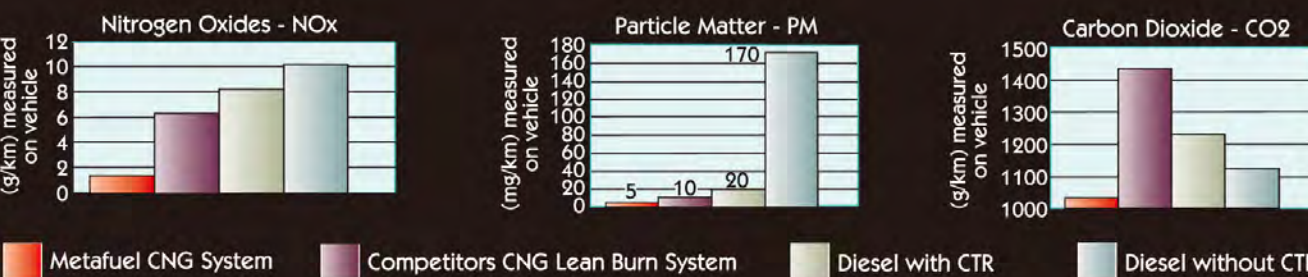


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METATRON is worldwide leader in the design and production of CNG and LNG automotive components and systems for OEM applications



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## EURO 5 & EURO 6 NATURAL GAS ENGINE CONTROL SYSTEM

## METATRON HDS ENGINE CONTROL SYSTEM

Metatron HDS is a stand-alone engine control system for 6-cylinder heavy duty natural gas engine (with displacement between 5 and 13 liters), based on

- Torque based control strategy
- Engine control strategies specific for natural gas (CNG & LNG)
- Stoichiometric combustion (optional Lean mix is available)
- Multi-Point sequential phased Injection (MPI)
- 3 way catalyst

Metatron HDS injection system includes an advanced and robust NG pressure regulator based on piston technology (high durability and reliability performance) suitable for most used injectors brands managed by ECU.

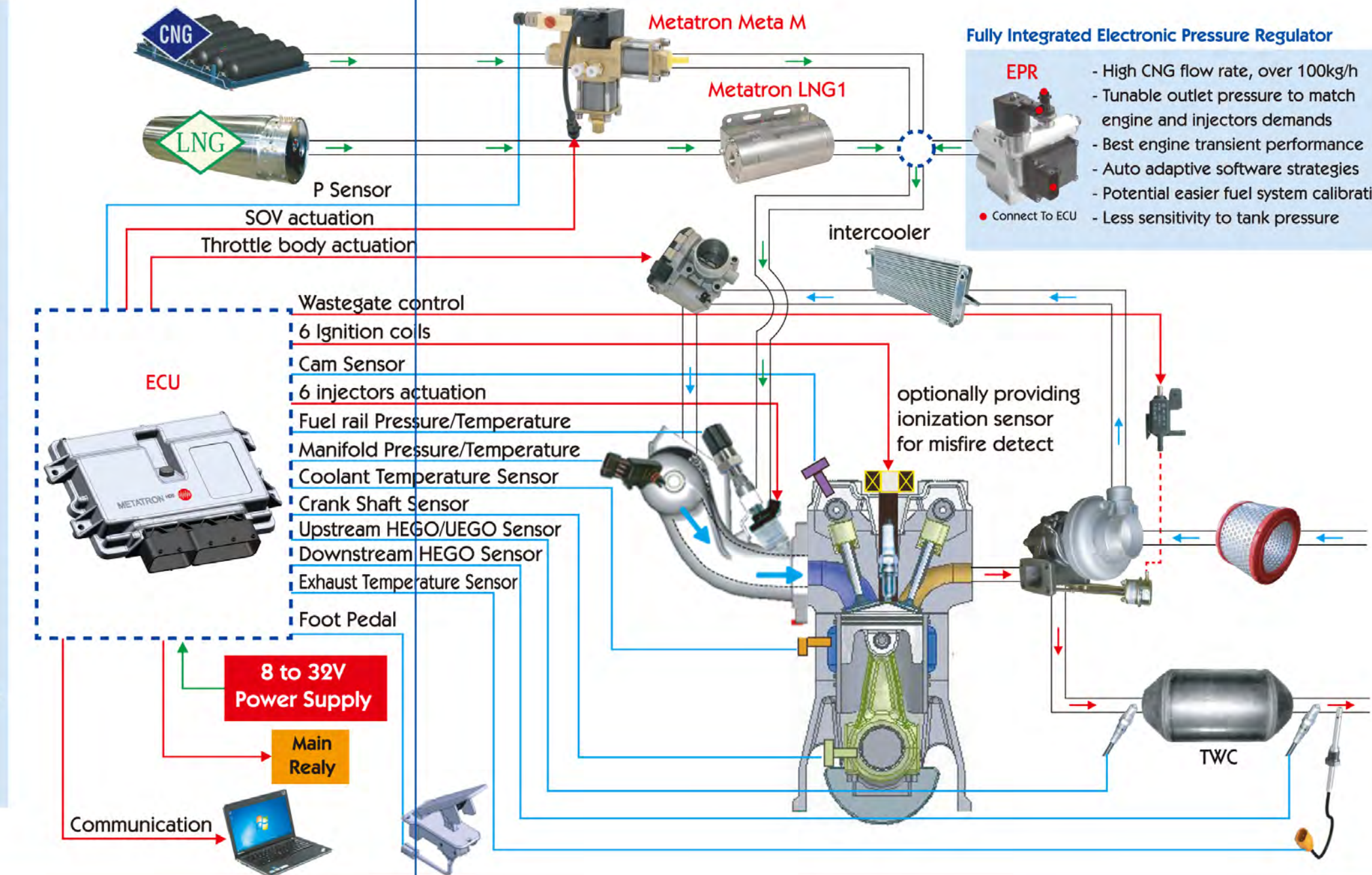
### The advantage of HDS

Comparing with pure lean-burn system, Metatron HDS has the following advantage:

- Euro 5 and Euro 6 with no compromises. The full EOBD compliance is achieved by:
  - 2 diagnosis strategies for NOx for 2 different thresholds (torque reduction recovery fully configurable)
  - misfire detection optionally based on crankshaft speed or ionization detect methods
- Engine cost: HDS meets Euro 6 emission without EGR, DOC or SCR; just needs 3-way catalyst.
- Catalyst cost: MPI provides more precision air-fuel ratio control. It reduces the precious metal loading in 3-way catalyst
- An integrated NG Electronic Pressure Regulator with tunable outlet pressure allows the fitting of every injectors brand at every fuel flow rates (more than 100 kg/h)
- Stable combustion, due to " $\lambda = 1$ "
- AT/AMT support: the precision torque control provides the good response to AT/AMT
- Drivability: less airflow, less turbo lag
- Thermal load: thanks to an optional wideband oxygen sensor, can automatically activate the lean burn to minimize the thermal load in particular operating conditions (off city usage)

### Best choice for OEM natural gas engine application now and future

- Developed for world class natural gas engine since 1995 in Italy
- Leading-edge multipoint sequential stoichiometric combustion technology
- One-stop system solution for Euro3/4/5/6 natural gas engine
- Worldwide used for OEM CNG and LNG engine
- Globally footprints supporting available
- Continuous investment and innovation for future environmental protection technologies and products



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## HDS Controller Brief

### Main features:

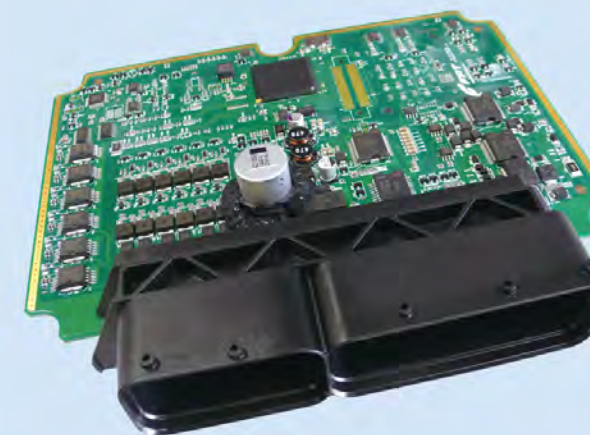
- Injectors management with "Peak & Hold" driving for engines up to six cylinders and up to two injectors for cylinder (max peak current = 6A, max hold current = 2A)
- Ignition management with direct control of "pencil coil" type for engines up to six cylinders (max collector current = 9A)
- Waste gate management for turbocharger control
- Engine coolant and inter-cooler FAN control with relays
- Electronic throttle (ETC) direct control
- Pre and post catalyst Lambda probes (on-off type) and heaters management
- The ECU is suitable for 24 volt applications and compliant to ECE R110 and R10 regulation
- High speed CAN (up to 500 Kbit/s) with J1939 communication
- Accelerator pedal management:
  - o Analogue signals coming from double trace potentiometer
  - o PWM signals
- Main engine information repetition (PWM signals) for dashboard
- K line for DATASET download and interface with the diagnostic tool (KW2000 protocol)

### Integrated performance:

- 6-16V power supply in vehicles with 12V battery voltage and 12-32V in vehicles with 24V battery voltage
- Connector pins protected against permanent short circuit to battery voltage and battery ground (with the exception of power supply pins)
- The ECU is protected against vehicle battery polarity inversion by means of an appropriate external fuse provided in the wiring harness
- Installation site: engine compartment (or other sites with less stringent environmental characteristics)
- Assembling position: The ECU can be mounted in vertical position (along vehicle Z axis) with the connector towards high or longitudinal position. Any other mounting position is not recommended
- Operating temperature: -30°C ~ +100°C
- Useful life: +85°C continuously for 20000 hours at 0.1m/s air flow rate
- Storage temperature: -40°C ~ +120°C
- ECU water protection degree is IP9K
- Test conditions for mechanical vibrations are:
  - o Sinusoidal vibrations, 8 hours along each axis, frequency from 5 to 50 Hz, peak to peak amplitude 5mm, acceleration 150m/s<sup>2</sup>

### Hardware details:

- 154 pins connector (90+64)
- 21 analog inputs
- Integrate barometer sensor in ECU
- 19 digital inputs
- 12 power outputs for injector and ignition
- 16 digital outputs:
  - o 8 channels low power: 0.5A RMS, 1 A peak
  - o 8 channels low/medium power: 1 A RMS, 3 A Peak
- 9 frequency outputs (PWM):
  - o 4 channels low power: 0.5A RMS, 1 A peak
  - o 3 channels low/medium power: 1 A RMS, 3 A Peak
  - o 2 channels medium power: 2 A RMS, 6 A Peak
- Communications:
  - o 2 high speed CAN, 2.0B
  - o 1 K-Line, IOS 9141
  - o 32 bit Micro-processor
- 1 M bytes of Flash, 32 K bytes of RAM, and 2 K bytes of EEPROM
- Supervisor controller: MC68HC908GR8



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