

# 4 stroke Diesel cycle

Compression ignition

Short time for injection and combustion



low maximum RPMs  
max power < petrol engines

Control parameter:  
fuel quantity  
(a Diesel engine always runs lean)



■ A: Intake      ■ B: Compression  
■ C: Power      ■ D: Exhaust

The Diesel engine differs from the petrol one because of the working cycle, which in this case is the «Diesel cycle» (from the name of its inventor Rudolph Diesel). As for the petrol engine, two are the main concepts:



## Structure of a Diesel engine

1. Air filter
2. MAF (Manifold Absolute Pressure) sensor
3. Turbocharger (high-pressure stage)
4. Turbocharger (low-pressure stage)
5. High-pressure stage supercharging pressure regulation valve
6. IAT (Intake Air Temperature) sensor
7. Intercooler
8. Electronic throttle valve
9. EGR (Exhaust Gas Recirculation) valve
10. EGR gas heat sink
11. Turbo pressure sensor
12. Engine
13. Electro-pneumatic turbo pressure regulation valve (exchange between high- and low-pressure stages)
14. Electro-pneumatic turbo pressure regulation valve (wastegate) (high-pressure stage)
15. Catalytic converter
16. FAP (anti-particulate filter)
17. Muffler (silencer)
18. ECU (Engine Control Unit)

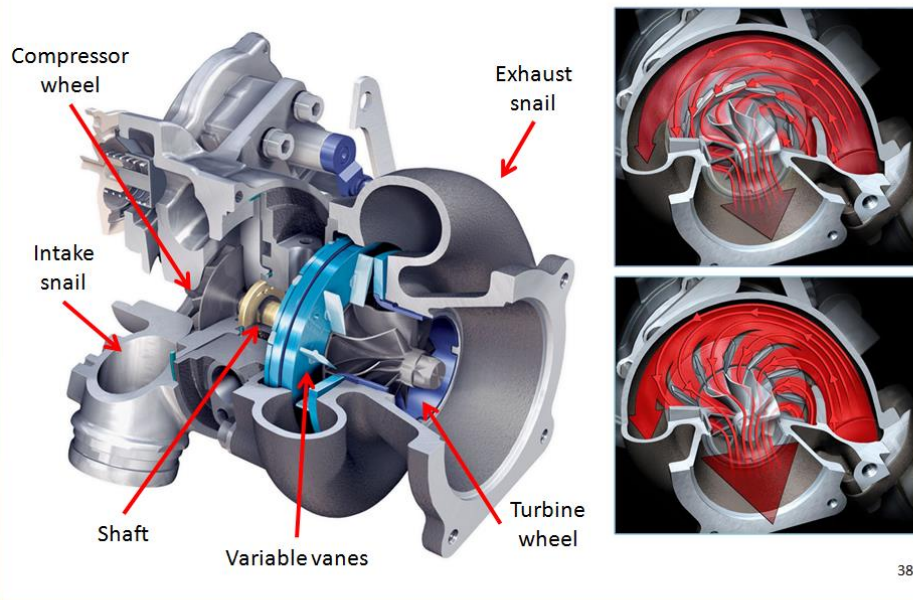


# Pump Injector system

1. High-pressure fuel circuit
2. Low-pressure fuel circuit
3. Fuel filters
4. Throw pump
5. Fuel level
6. Connection of the low pressure fuel return circuit
7. Connection of the low pressure fuel feeding circuit
8. Connection of the high pressure fuel feeding circuit
9. Connection of air bleeding
10. Fuel filter and temperature sensor
11. High pressure fuel return circuit cooler
12. Fuel pressure regulator
13. Injectors



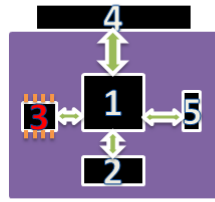
# Variable Geometry Turbocharger (VGT)



More recently, the development of Variable Geometry Turbochargers (VGT) allowed an increase of performances and a parallel reduction of costs and dimensions: a single turbocharger of this kind is indeed able to grant high efficiency at any revolution speed.



# ECU: Engine Control Unit



## 3. EEPROM, E<sup>2</sup>PROM (8 pin) Vehicle data memory

### Security:

- VIN (Vehicle Identification Number)
- Key codes
- Immobilizer
- Diagnostic Trouble Codes (DTC) (opt.)

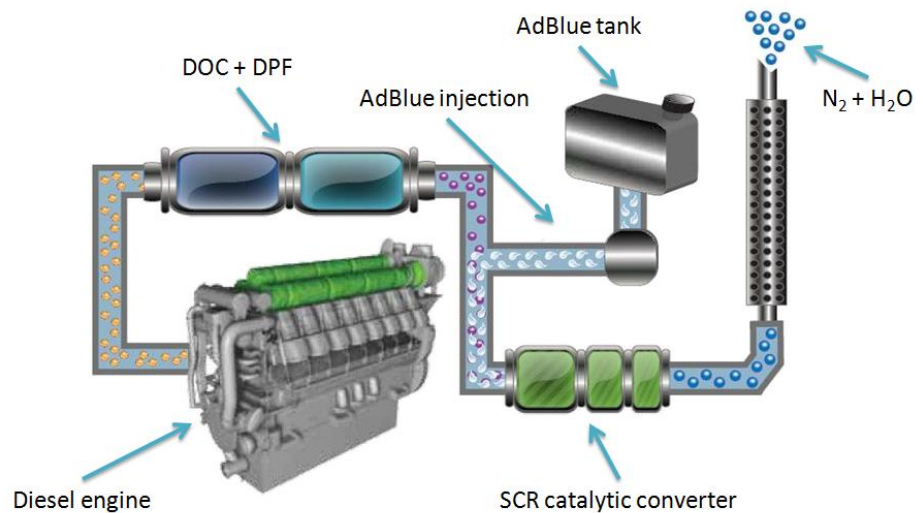
### Configuration:

- Mileage (opt.)
- Wheel size supported list
- Injectors codification (opt. for Diesel)
- Speed limiter (opt.)
- Serial flash counters (opt.)

Another memory chip on the ECU's PCB is of our interest and ever present: the EEPROM, or E<sup>2</sup>PROM. It is much smaller than the Flash chip both

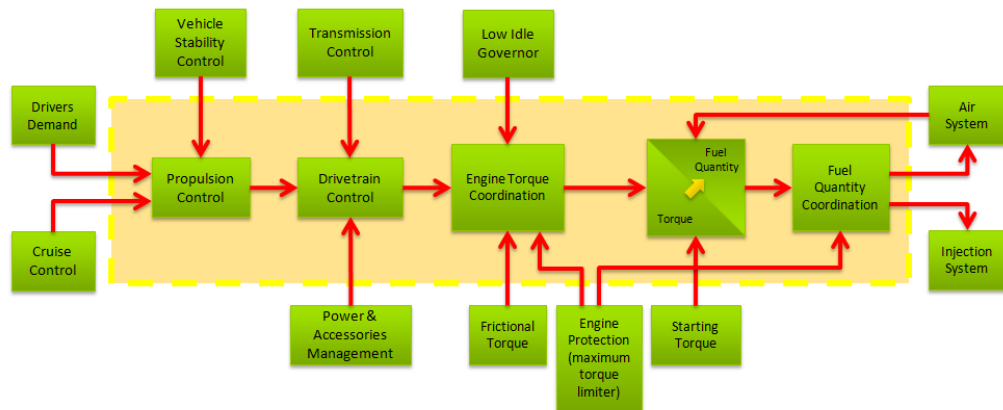


# SCR (DeNOx)



Goal of the SCR (Selective Catalytic Reduction) system, or DeNOx, is to reduce the emission of NOx through a selective reduction process: an injector sprays a solution of urea (AdBlue, BlueDEF) in the exhaust flow; NOx, so added, reach the SCR catalytic converter and get here

# Torque-based engine control



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# Bosch ECU models

Diesel: EDC x

E.g.: EDC 16U31

EDC = Electronic Diesel Control

V = Distributor injection pump (Verteiler Einspritzpumpe) (e.g. EDC 15V)

P = Pump-nozzle (Pumpe-düse) (e.g. EDC 15P)

U = Pump-nozzle (e.g. EDC 16U, EDC 17U)

C = Common Rail with 1 MB external Flash chip (e.g. EDC 16C)

CP = Common Rail with 2 MB external Flash chip (e.g. EDC 16CP, EDC 17CP)

Petrol: M x

E.g.: MED 17.5

M = Motronic (Motorelektronik)

E = Electronic throttle (Electronic Throttle Control)

D = Direct injection inside cylinder (Direct Injection)

G = ETC with integrated transmission control (Getriebesteuerung)

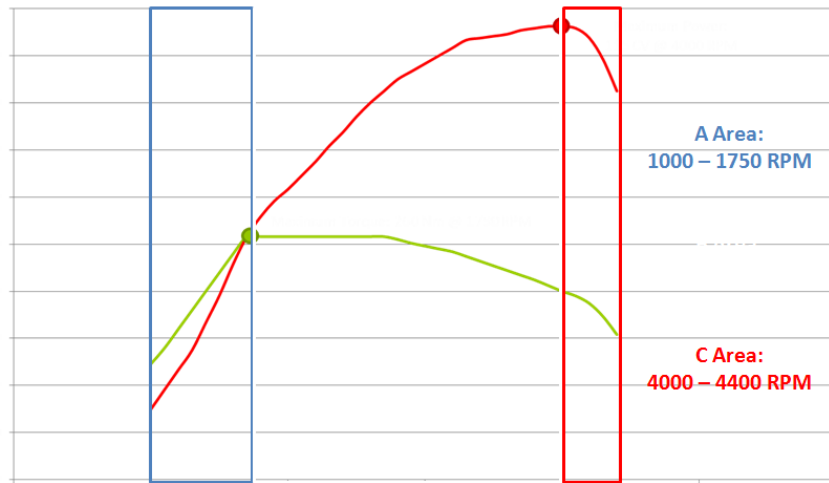
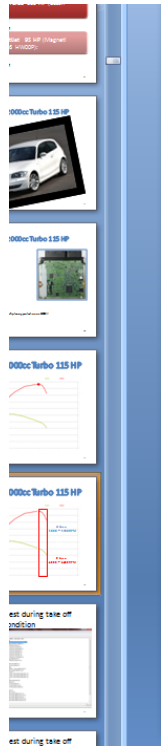
V = ValvetronicSystem (patented by BMW)

C = Common Rail

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Remaining in Bosch, it is quite simple to obtain some additional information from the ECU name, which is often written on the label. The following list does not claim to be perfectly complete and accurate... but it comes from our experience and can be useful.

# BMW 116d 2000cc Turbo 115 HP



## Limiter of Maximum torque



ECM Titanium 1.50 - Edit map: Limiter of Maximum torque - Allowed Values:0.0 - 3277.0

RPM	Nm
700	270,0
800	270,0
1000	240,0
1250	230,0
1500	285,0
1750	333,2
2000	333,2
2250	333,2
2500	333,8
2750	329,5
3000	323,0
3500	312,6
4000	308,0
4200	285,9
4400	266,5
4600	246,6
4800	204,0
5000	56,4
5020	58,0
5100	0,0
5200	0,0

Interpolation

Parameters

Linear (plane surface)

top-left / bottom-right

top-right / bottom-left

Curved surface

by rows

by columns

Compute increment

Absolute

Percent

Increment values

RPM	Nm
1000	9
1750	11

OK Cancel

Loaded data		Checksum	Even	Odd	16 bit	32 bit
Original	8068_564.DRI	4F3C	3455	1AE7	2FA91855	1CAFAF3C
Modified	8068_564.DRI					

Inst: 057C60 Size: 21x1 K: 0.1 Checksum: NO