School of Pedagogical and Technological Education
ASPETE

ΜΕΚ ΙΙ

Συστήματα ελέγχου αέρα εισαγωγής

Δρ. Αντώνης Αντωνόπουλος

ΜΕΚ ΙΙ – Συστήματα ελέγχου αέρα εισαγωγής

Περιεχόμενα

Electronic throttle control (ETC)

Variable valve timing

Dynamic supercharging

Mechanical supercharging

Exhaust-gas turbocharging

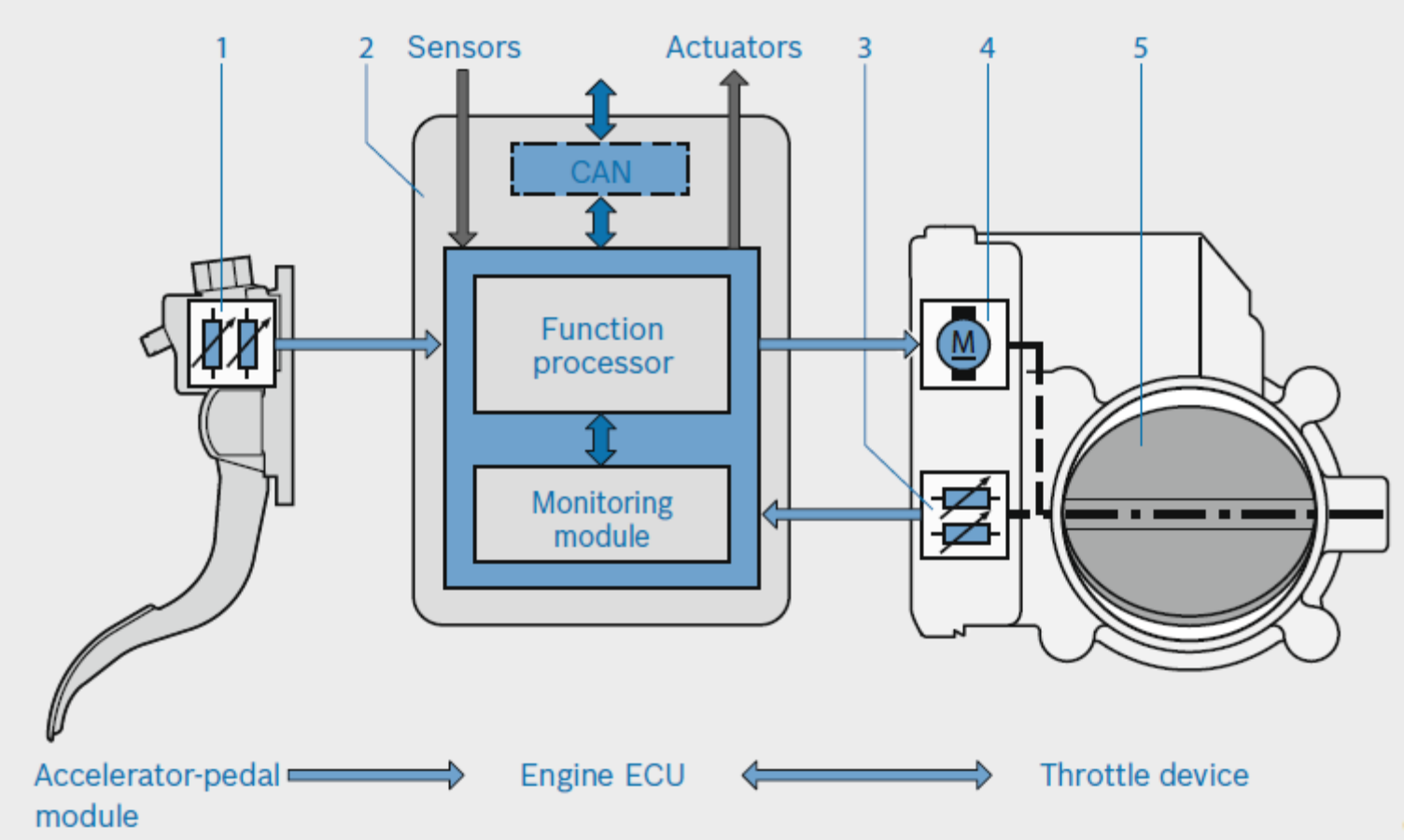
Intercooling

Controlled charge flow

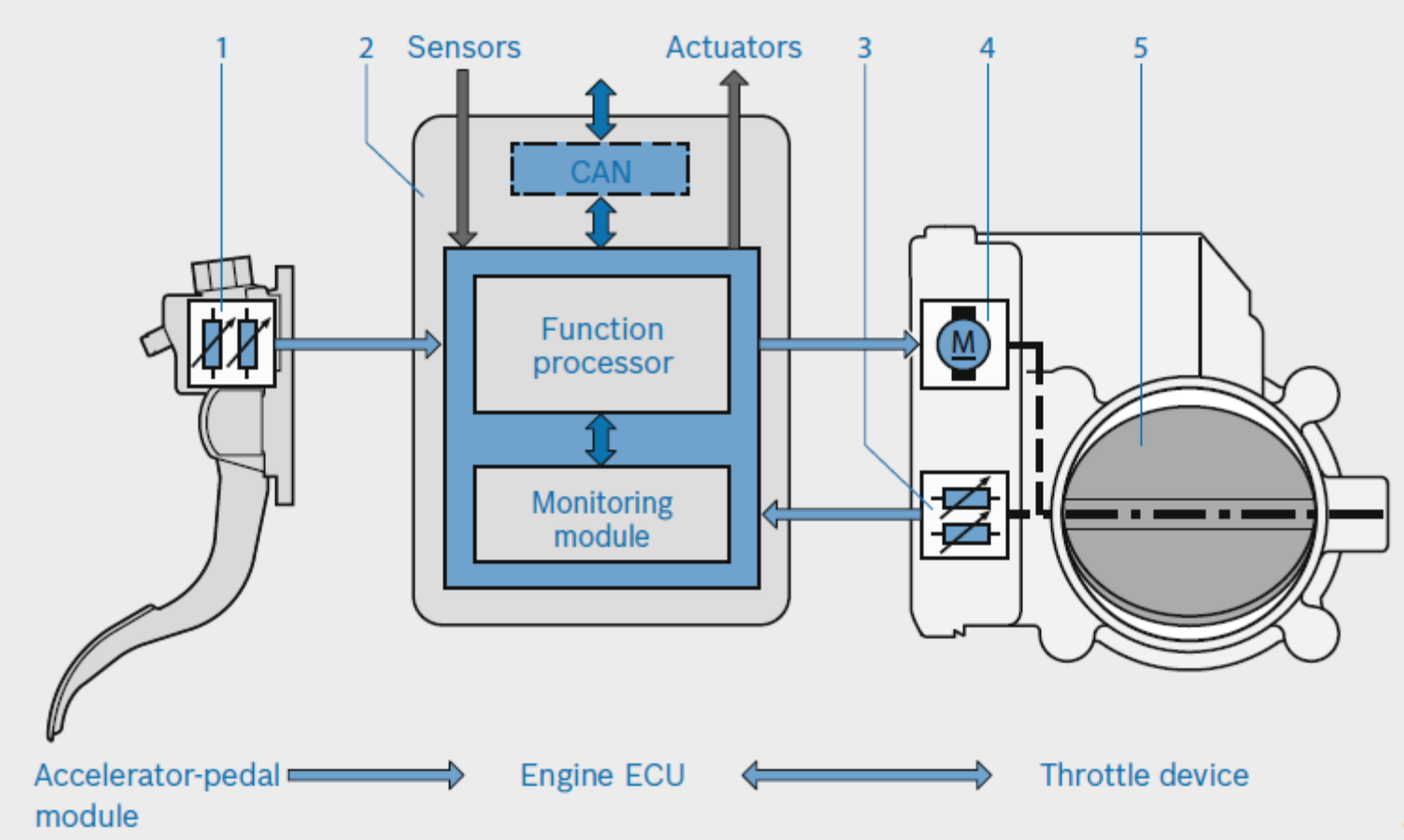
Exhaust-gas recirculation (EGR)

ΜΕΚ ΙΙ – Συστήματα ελέγχου αέρα εισαγωγής

Ηλεκτρονικός Έλεγχος Πεταλούδας (Electronic throttle control (ETC))



Ηλεκτρονικός Έλεγχος Πεταλούδας (Electronic throttle control (ETC))



Ηλεκτρονικός Έλεγχος Πεταλούδας (ETC) - Πεταλούδα

1 Pneumatic housing
2 Throttle valve
3 DC motor
4 Plug module
5 Gear-unit housing
6 Integrated throttlevalve-angle sensor
7 Cover module

Ηλεκτρονικός Έλεγχος Πεταλούδας (ETC) – Αισθητήρας πεντάλ : αντίστασης

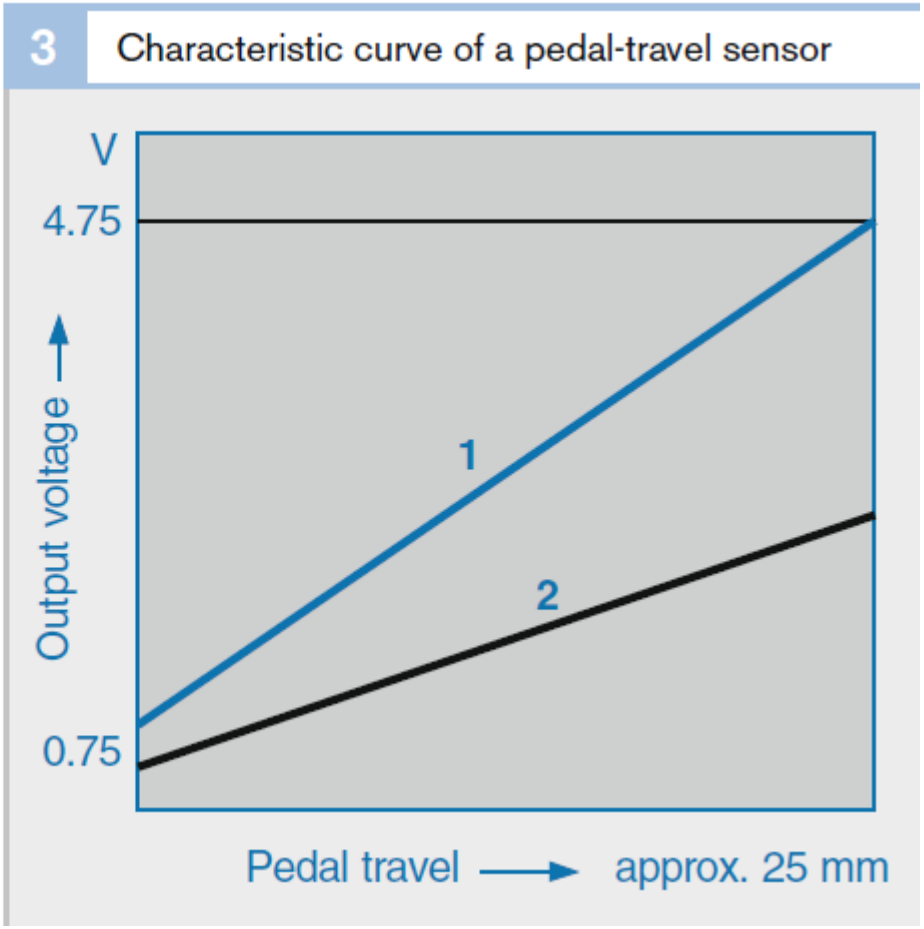
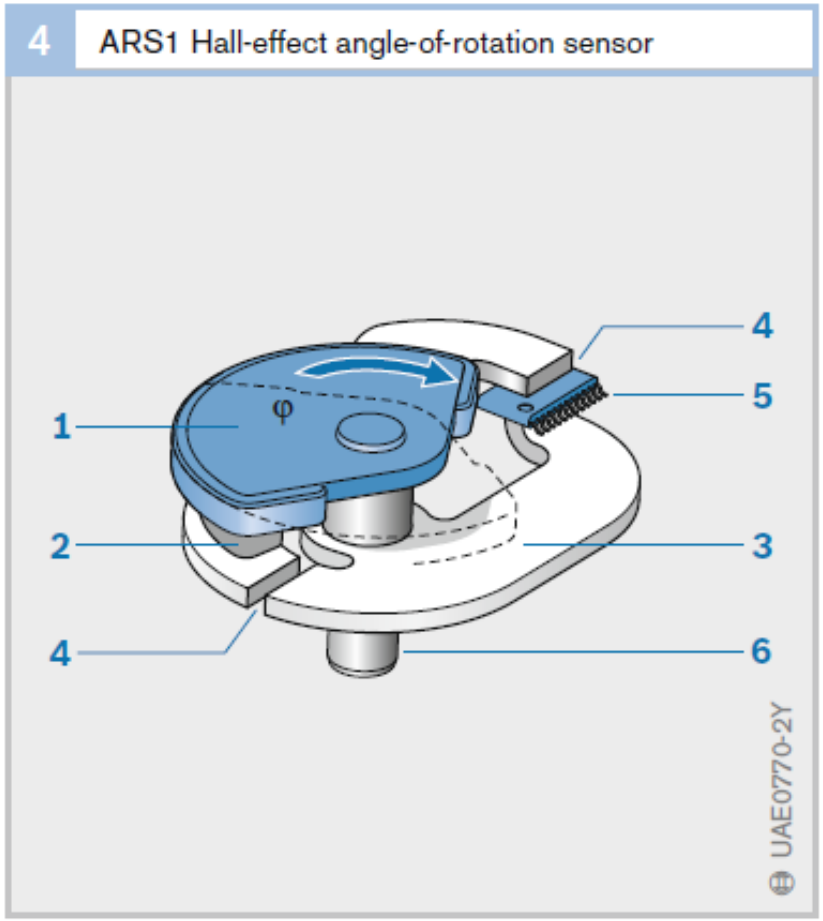


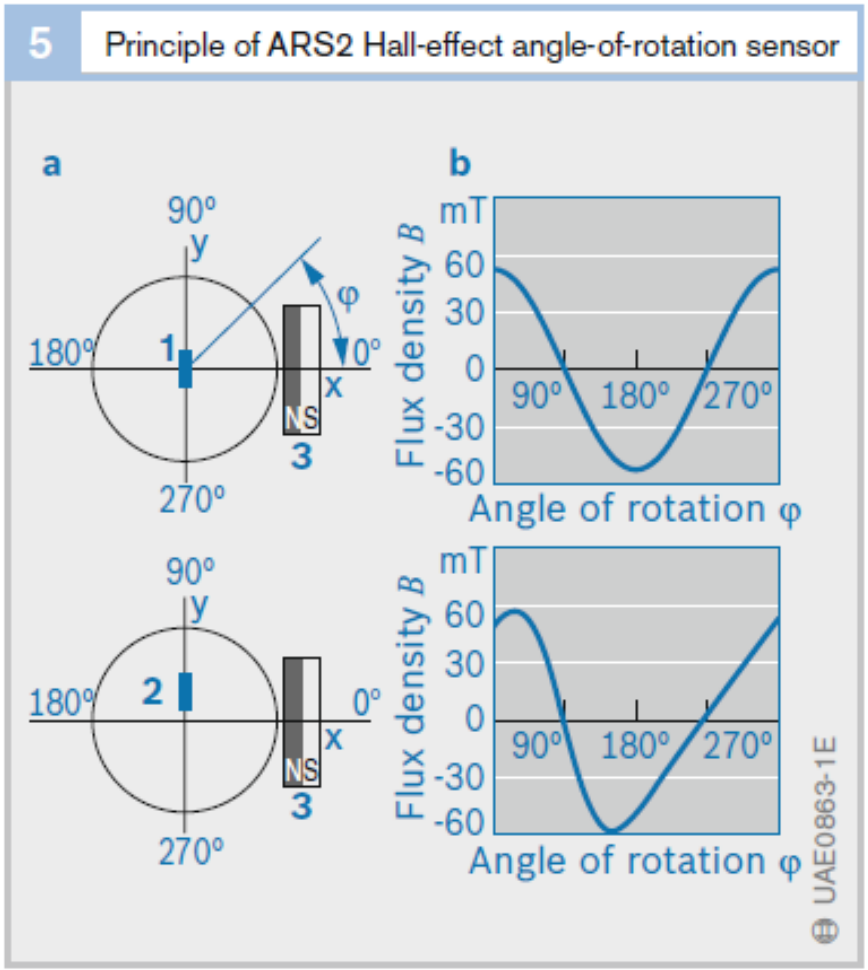
Fig. 3
1 Potentiometer (reference potentiometer)
2 Potentiometer (half voltage)

Ηλεκτρονικός Έλεγχος Πεταλούδας (ETC) – Αισθητήρας πεντάλ : Φαινομένου Hall



1 Rotor disc (permanent magnetic)
2 Pole shoe
3 Conductive element
4 Air gap
5 Hall-effect sensor
6 Shaft (soft magnetic)

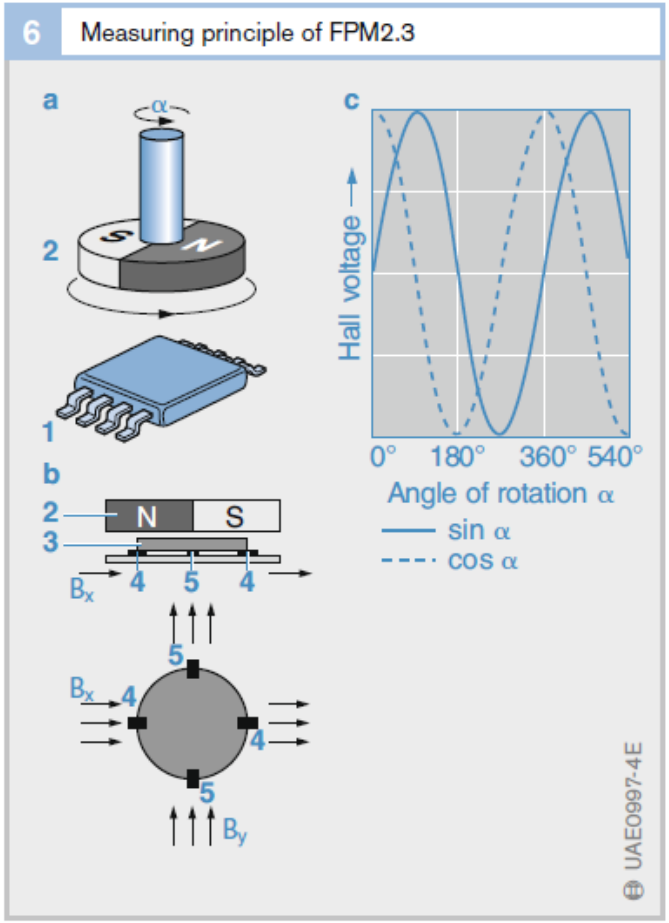
Ηλεκτρονικός Έλεγχος Πεταλούδας (ETC) – Αισθητήρας πεντάλ : Φαινομένου Hall

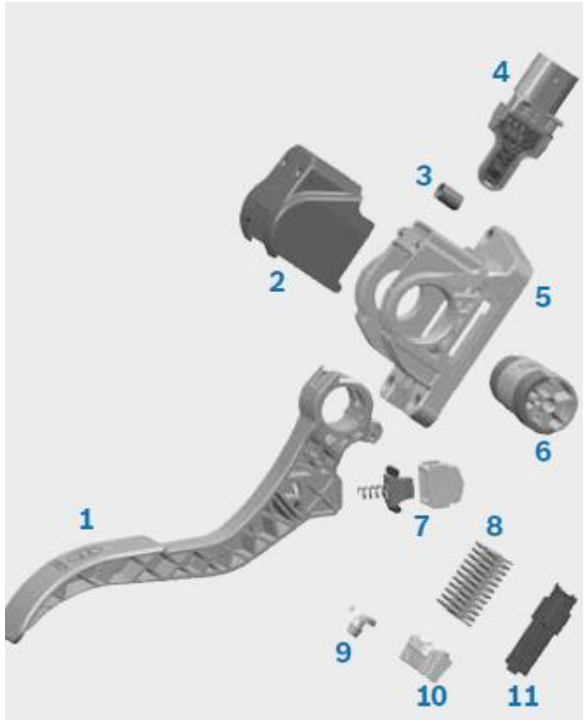


1 Hall IC positioned in the mid-point of the circular path
2 Hall IC located outside the midpoint (linearization)
3 Magnet

ΜΕΚ ΙΙ – Συστήματα ελέγχου αέρα εισαγωγής

Ηλεκτρονικός Έλεγχος Πεταλούδας (ETC) – Αισθητήρας πεντάλ : Φαινομένου Hall





1 Pedal
2 Cover
3 Spacer sleeve
4 Sensor block with housing and plug
5 Bearing block
6 Shaft with two magnets and hysteresis elements (round magnets not visible)
7 Kickdown (optional)
8 Two springs
9 Stop damper
10 Thrust member
11 Floor cover

1 Integrated Circuit (IC) with Hall-effect elements
2 Magnet (opposing magnet not shown here)
3 Conductive element
4 Hall-effect elements (for recording x-component of *B*)
5 Hall-effect elements (for recording y-component of *B*)

Μεταβλητός Χρονισμός Βαλβίδας

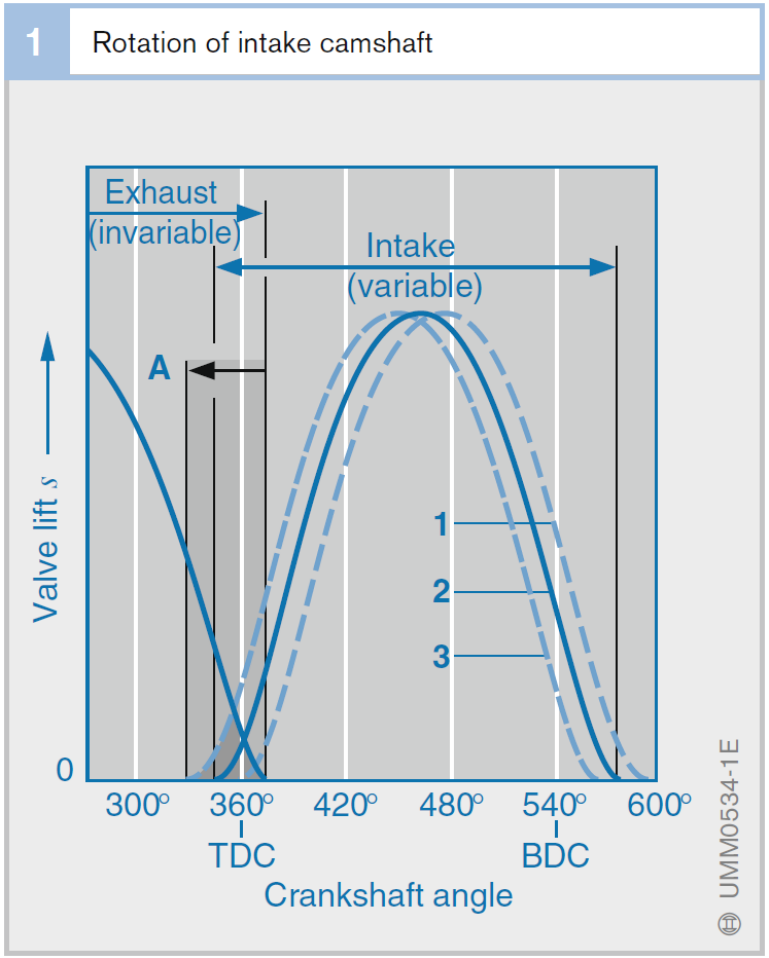
Παράμετροι:
Χρονισμός και ανύψωση

Λειτουργίες
Ρύθμιση αναλογίας φρέσκου αέρα και αέρα από ανακυκλοφορία
Καλύτερη απόπλυση

Οφέλη:
Βέλτιστη λειτουργία σε μεγαλύτερο εύρος στροφών

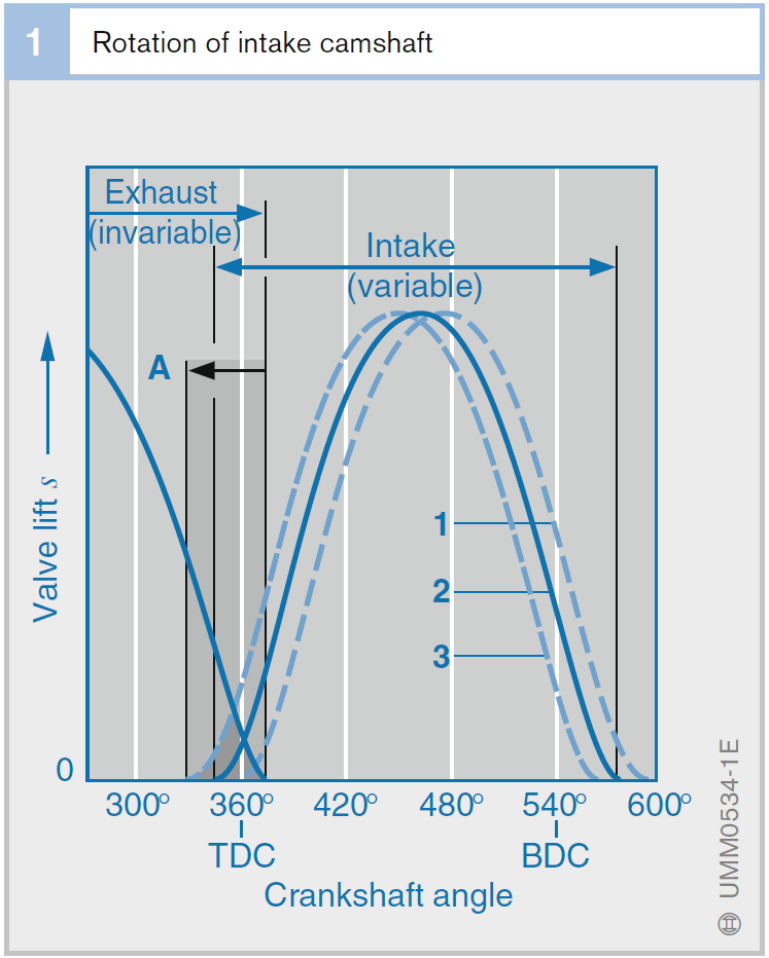
- Higher rated power
- Favorable torque curve over the entire engine-speed range
- Reduction of toxic emissions
- Reduced fuel consumption, and
- Improved smooth running at low engine speeds

Μεταβλητός Χρονισμός Βαλβίδων – Ρύθμιση φάσης εκκεντροφόρου



1 Rotation in "Retard" direction
2 Normal position
3 Rotation in "Advance" direction
A Valve overlap

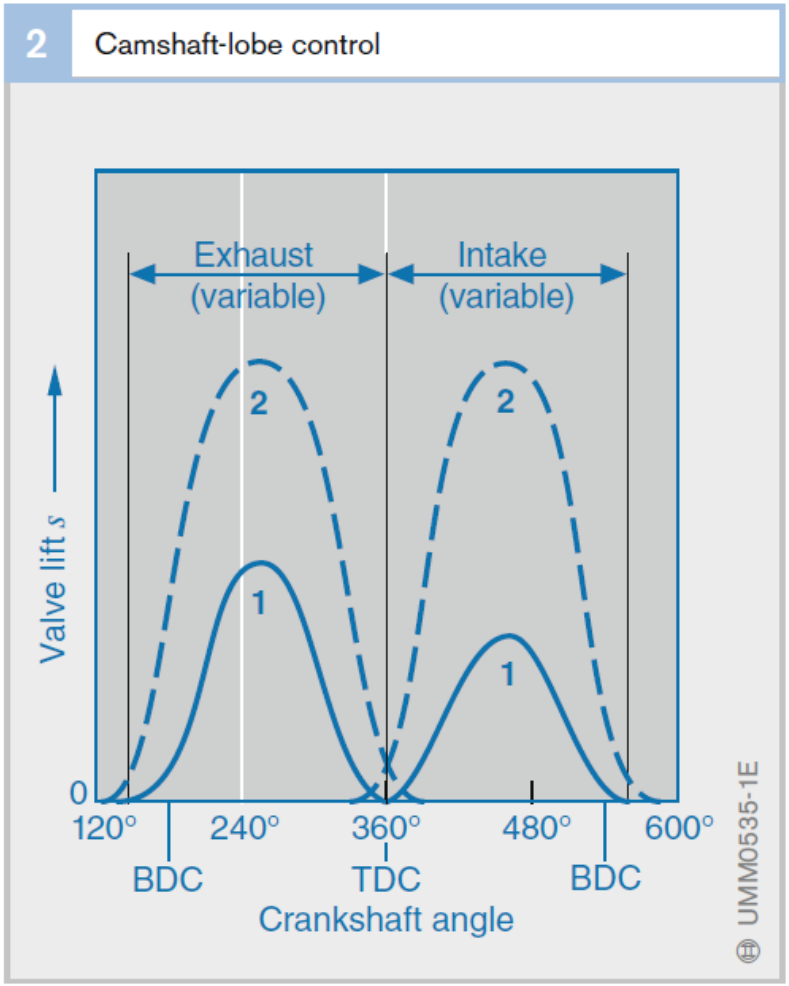
Μεταβλητός Χρονισμός Βαλβίδων – Ρύθμιση φάσης εκκεντροφόρου



- Βραδυπορία
  - Χαμηλές ταχύτητες
  - Υψηλές Ταχύτητες
- Προπορεία
  - Μέσες Ταχύτητες

1 Rotation in "Retard" direction
2 Normal position
3 Rotation in "Advance" direction
A Valve overlap

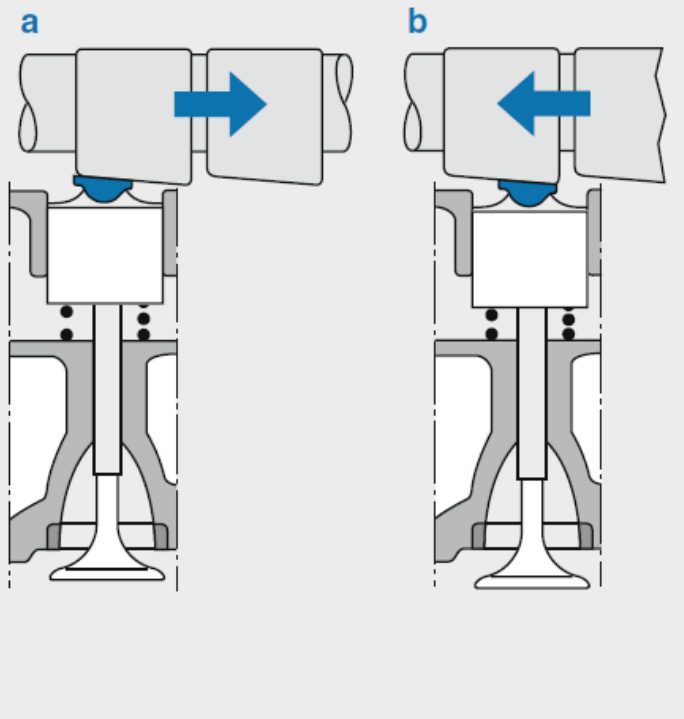
Μεταβλητός Χρονισμός Βαλβίδων – Έλεγχος εκκέντρων



1 Standard cam
2 Additional cam

Μεταβλητός Χρονισμός Βαλβίδων – Πλήρως μεταβλητός χρονισμός με εκκεντροφόρο

3 Example of a system with infinitely variable valve timing and valve lift



Μεταβλητός Χρονισμός Βαλβίδων – Πλήρως μεταβλ. χρονισμός χωρίς εκκεντροφόρο

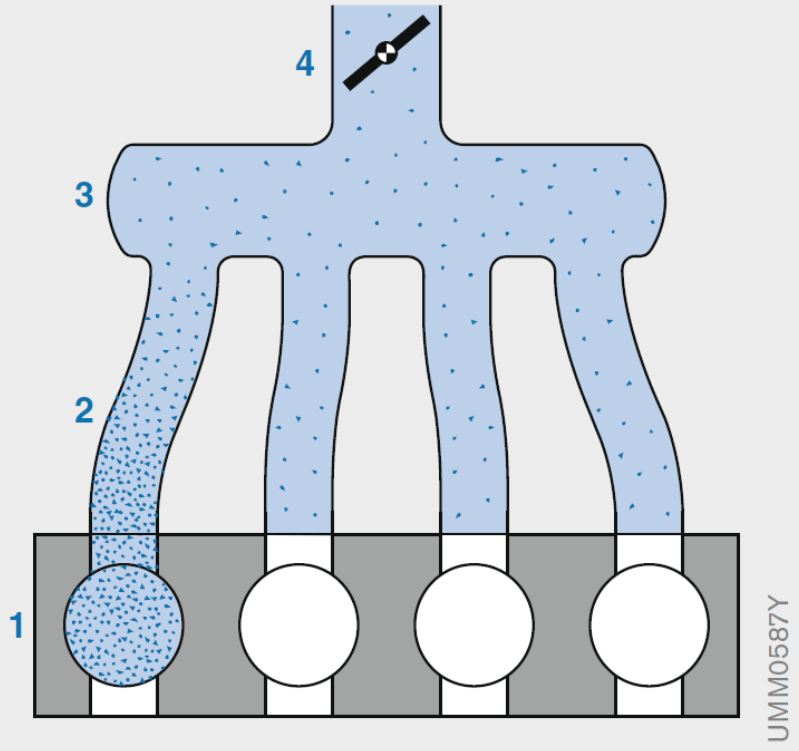
Electromechanical Valve Actuator

Δυναμική Υπερπλήρωση

Καθοδική κίνηση εμβόλου
↓
Κύμα πίεσης
↓
«Ανάκλαση» κύματος πίεσης
↓
Δυναμική υπερπλήρωση

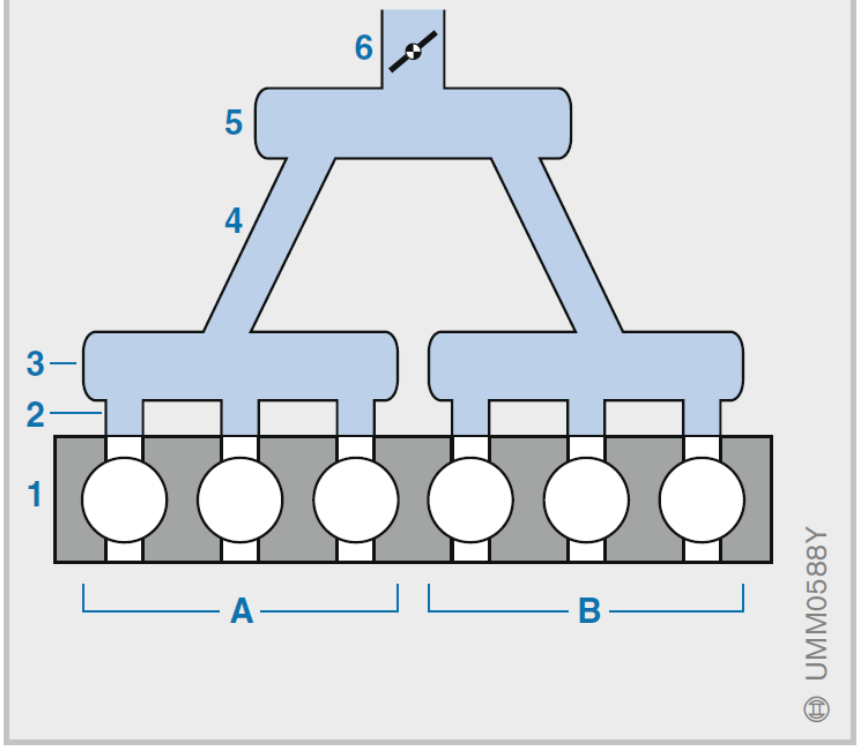
Δυναμική Υπερπλήρωση – Στατικοί σωλήνες εισώθησης (ram tube)

1 Principle of ram-tube supercharging



Δυναμική Υπερπλήρωση – σωλήνες συντονισμού (tuned-intake-tubes)

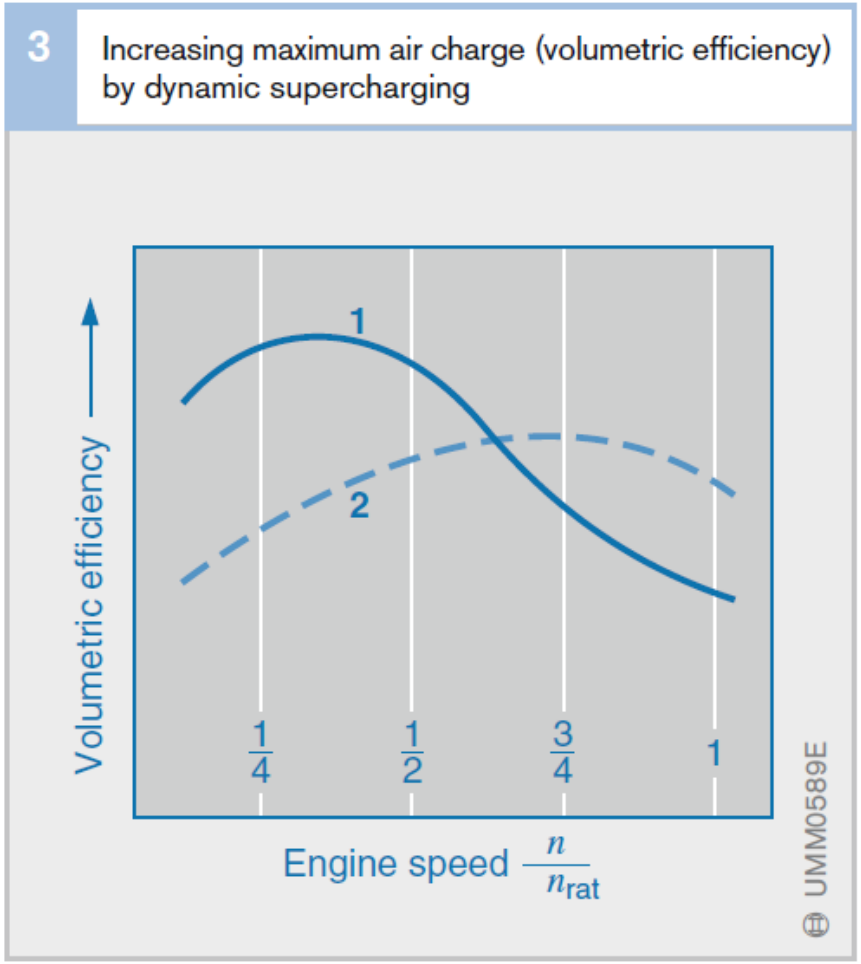
2 Principle of tuned-intake pressure charging



1 Cylinder
2 Short tube
3 Resonance chamber
4 Tuned intake tube
5 Manifold chamber
6 Throttle valve

A Cylinder group A
B Cylinder group B

Δυναμική Υπερπλήρωση – Οχετοί εισαγωγής μεταβλητής γεωμετρίας



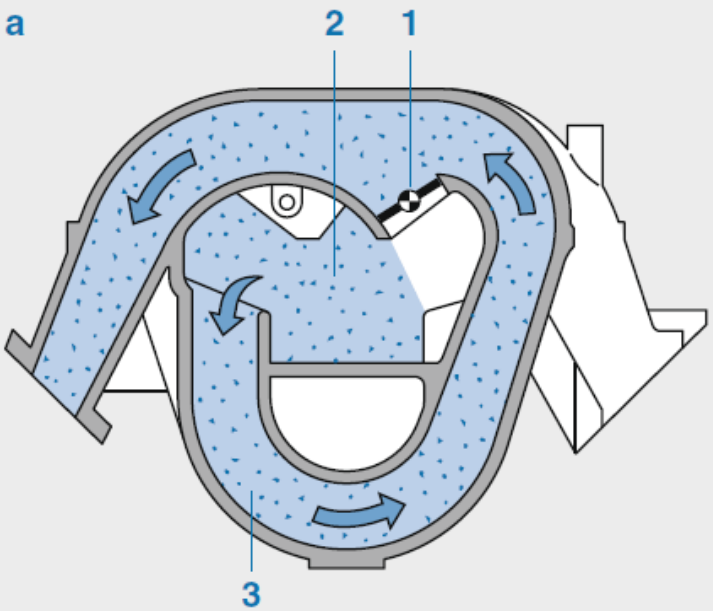
- Adjustment of the ram-tube length
- Switchover between different ram-tube lengths or different tube diameters
- Selected switchoff of one of the cylinder's intake tubes on multiple-tube systems
- Switchover to different chamber volumes

1 System with tuned intake pressure charging
2 System with conventional intake manifold

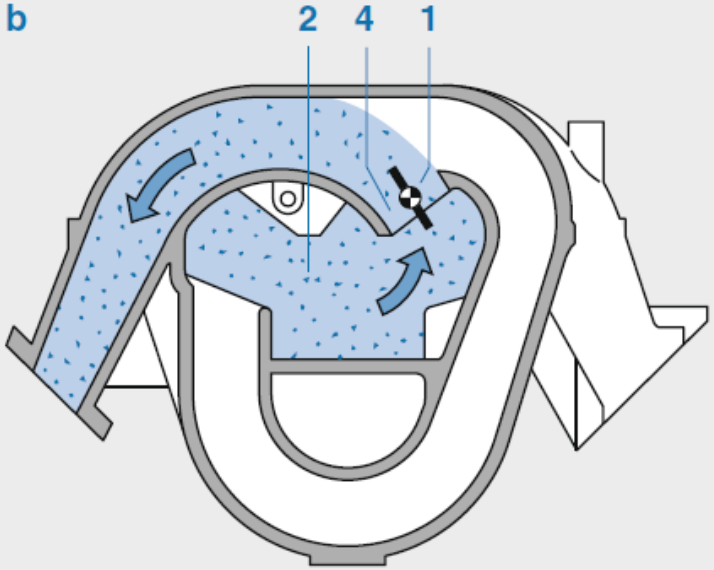
ΜΕΚ ΙΙ – Συστήματα ελέγχου αέρα εισαγωγής

Δυναμική Υπερπλήρωση – Οχετοί εισαγωγής μεταβλητής γεωμετρίας – Σωλήνες εισώθησης

Manifold geometry with changeover flap closed



Manifold geometry with changeover flap open

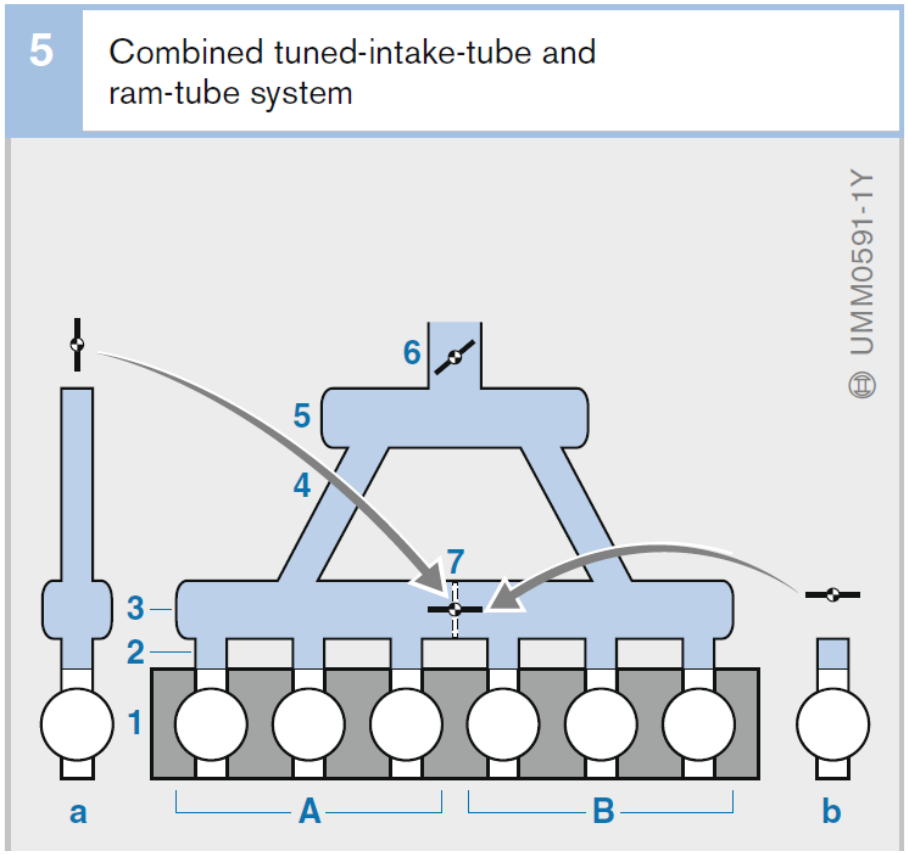


1 Changeover flap
2 Manifold chamber
3 Changeover flap closed: long, narrow diameter ram tube
4 Changeover flap opened: short, wide diameter ram tube

ΜΕΚ ΙΙ – Συστήματα ελέγχου αέρα εισαγωγής

Δυναμική Υπερπλήρωση – Οχετοί εισαγωγής μεταβλητής γεωμετρίας – Σωλήνες συντονισμού

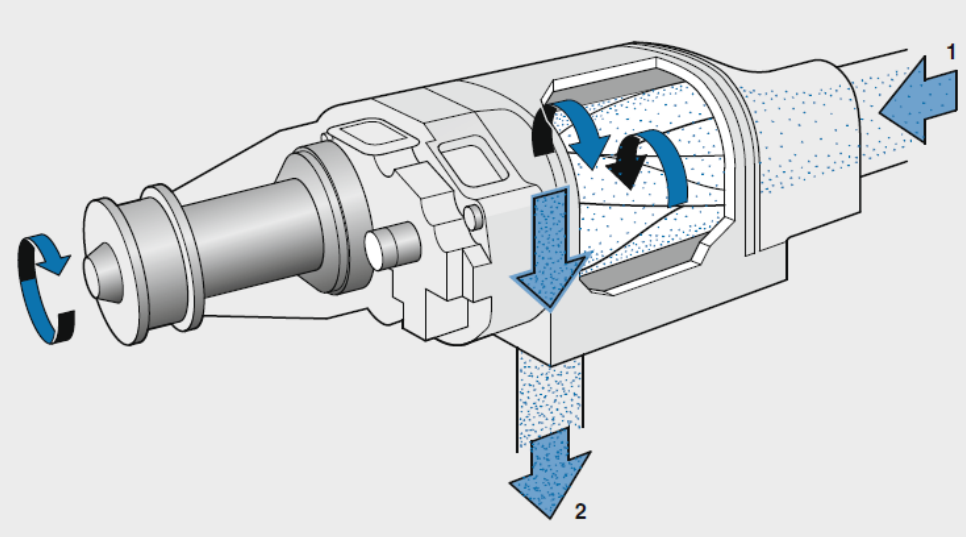
Δυναμική Υπερπλήρωση – Οχετοί εισαγωγής μεταβλητής γεωμετρίας – Συνδιασμός σωλήνων συντονισμού και εισώθησης



1 Cylinder
2 Ram tube (short intake tube)
3 Resonance chamber
4 Tuned intake tube
5 Manifold chamber
6 Throttle valve
7 Changeover flap

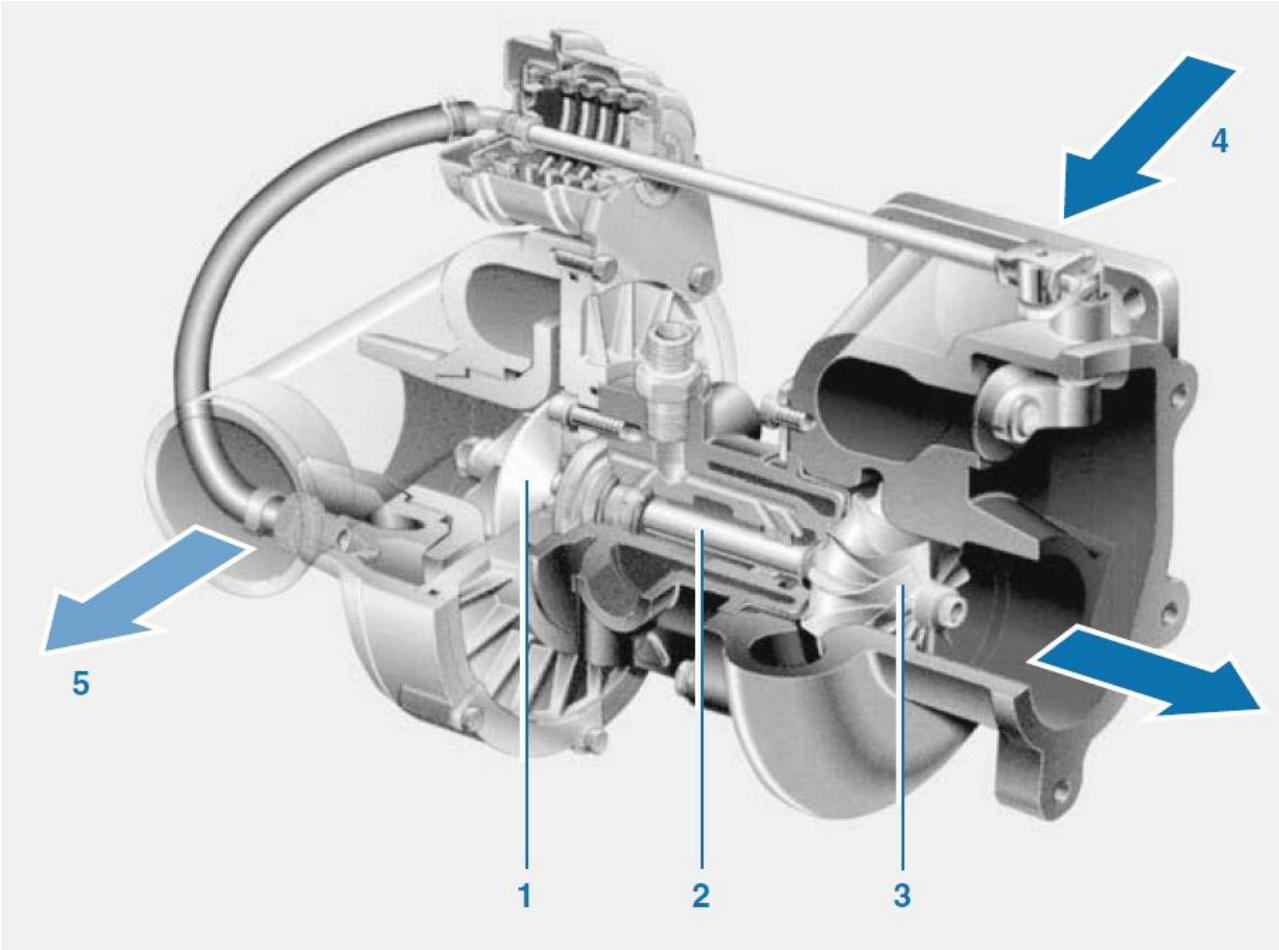
A Cylinder group A
B Cylinder group B
a Intake-tube conditions with changeover flap closed
b Intake-tube conditions with changeover flap open

Μηχανική Υπερπλήρωση



- Positive-displacement superchargers
  - roots supercharger,
  - Sliding vane supercharger,
  - spiral-type supercharger,
  - screw-type supercharger
- Centrifugal turbo-compressors
  - Radial-flow compressor

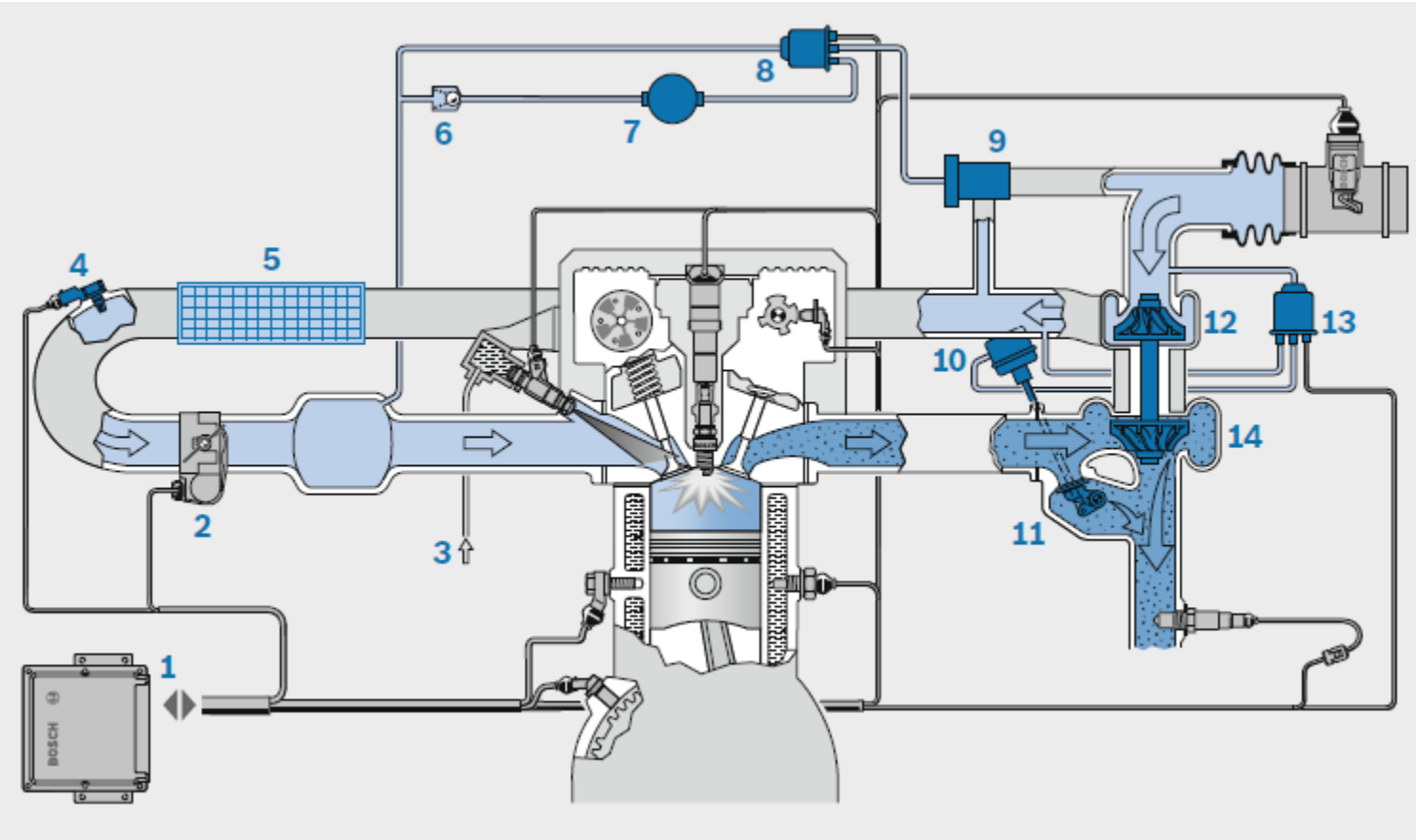
Στροβιλουπερπλήρωση



1 Compressor impeller
2 Shaft
3 Exhaust-gas turbine
4 Inlet for exhaust-gas mass flow
5 Outlet for compressed air

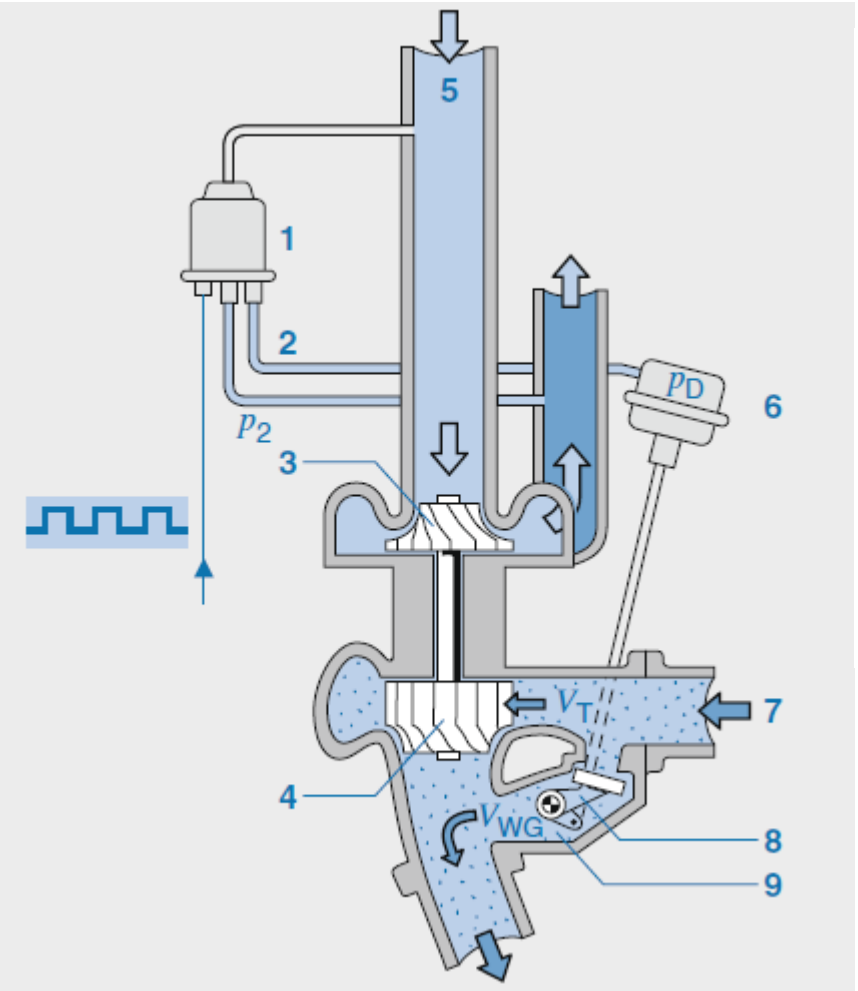
ΜΕΚ ΙΙ – Συστήματα ελέγχου αέρα εισαγωγής

Στροβιλουπερπλήρωση



1 Engine ECU
2 Throttle device
3 Fuel supply
4 Charge-air pressure and charge-air temperature sensor
5 Intercooler
6 Non-return valve
7 Vacuum reservoir
8 Solenoid valve (pulse valve)
9 Divert-air valve (dump valve)
10 Boost-pressure control valve
11 Wastegate (bypass valve)
12 Turbocharger compressor
13 Solenoid valve (pulse valve)
14 Exhaust-gas turbine

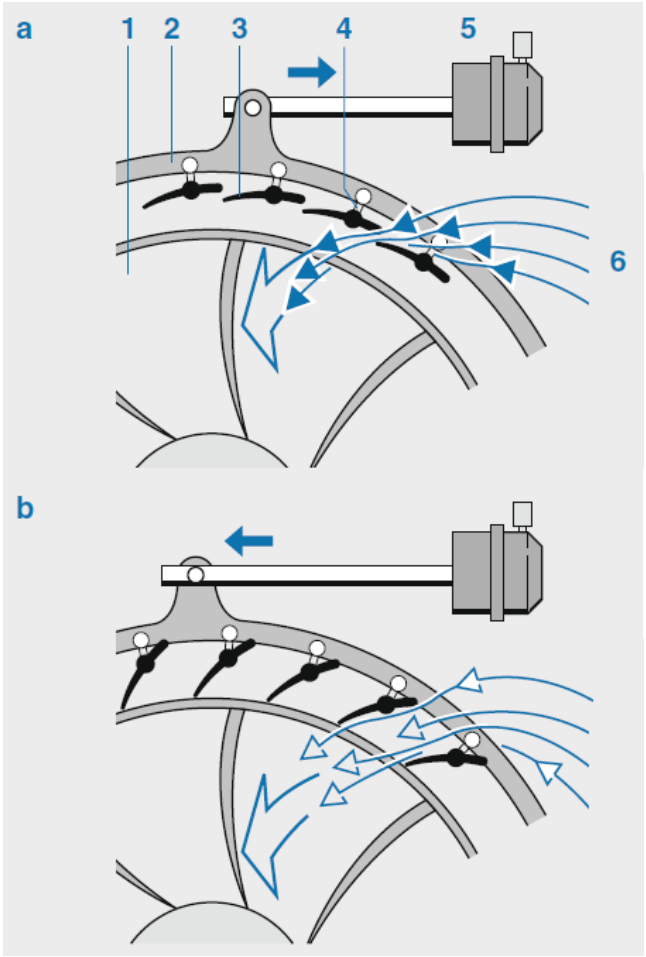
Στροβιλουπερπλήρωση – Σχεδιασμός - Wastegate



1 Pulse valve
2 Pneumatic control line
3 Compressor
4 Exhaust-gas turbine
5 Fresh incoming air
6 Boost-pressure control valve
7 Exhaust gas
8 Wastegate
9 Bypass duct

Triggering signal for pulse valve
V_T Volume flow through the turbine
V_{WG} Volume flow through the wastegate
p_2 Boost/charge-air pressure
p_D Pressure on the valve diaphragm

Στροβιλουπερπλήρωση – Σχεδιασμός - Μεταβλητή Γεωμετρία Στροβίλου



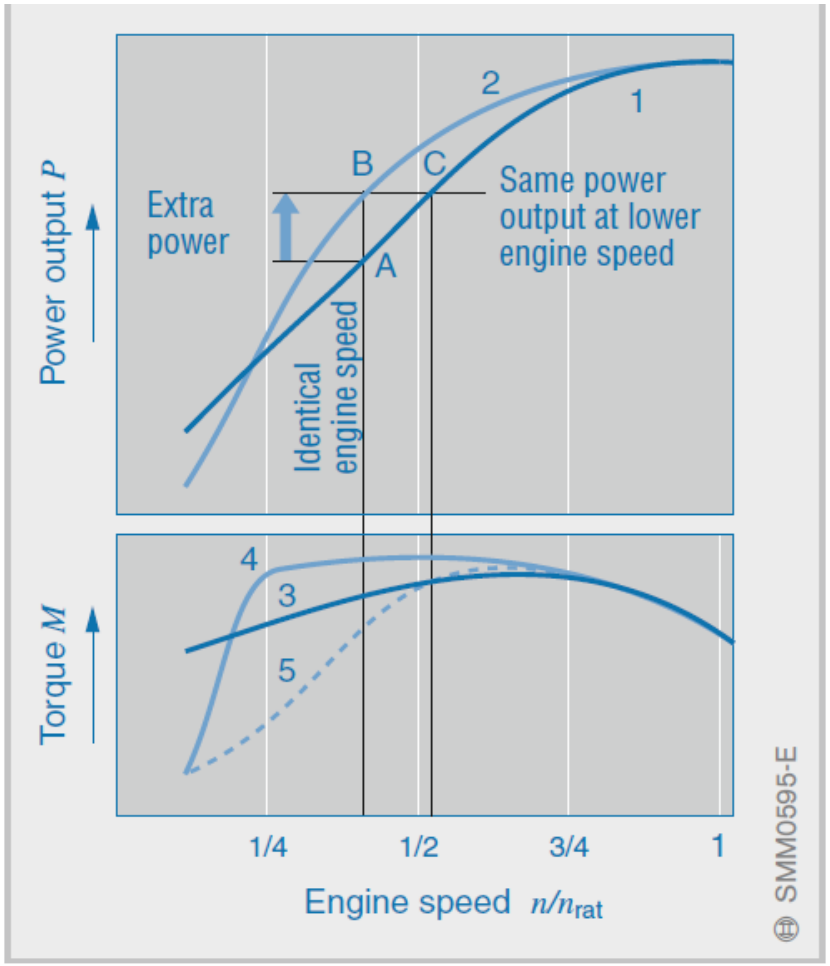
a Guide-vane setting for high charge-air pressure

b Guide-vane setting for low charge-air pressure

1 Turbine
2 Adjusting ring
3 Guide vanes
4 Adjusting lever
5 Barometric cell
6 Exhaust-gas flow

◀– High flow velocity
◁– Low flow velocity

Στροβιλουπερπλήρωση – Πλεονεκτήματα και Μειονεκτήματα

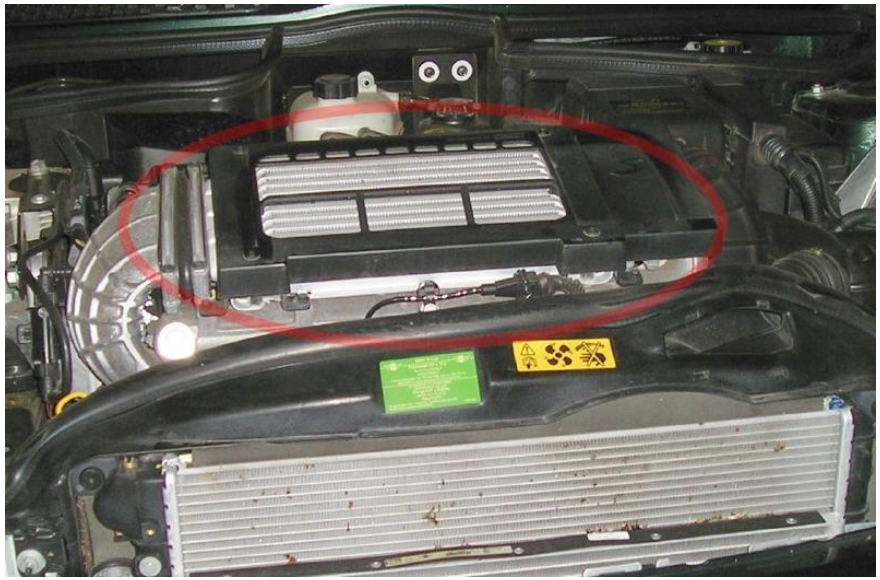


1, 3 Naturally aspirated engine in steady-state operation

2, 4 Supercharged engine in steady-state operation

5 Torque curve of the supercharged engine in transient (dynamic) operation

Ψύξη αέρα πλήρωσης (intercooling)



- Reduced tendency to knock
- Improved thermal efficiency
- resulting in lower fuel-consumption figures
- Reduced thermal loading of the pistons
- Lower NOX emissions
- Higher power yield

Έλεγχος ροής αέρα πλήρωσης

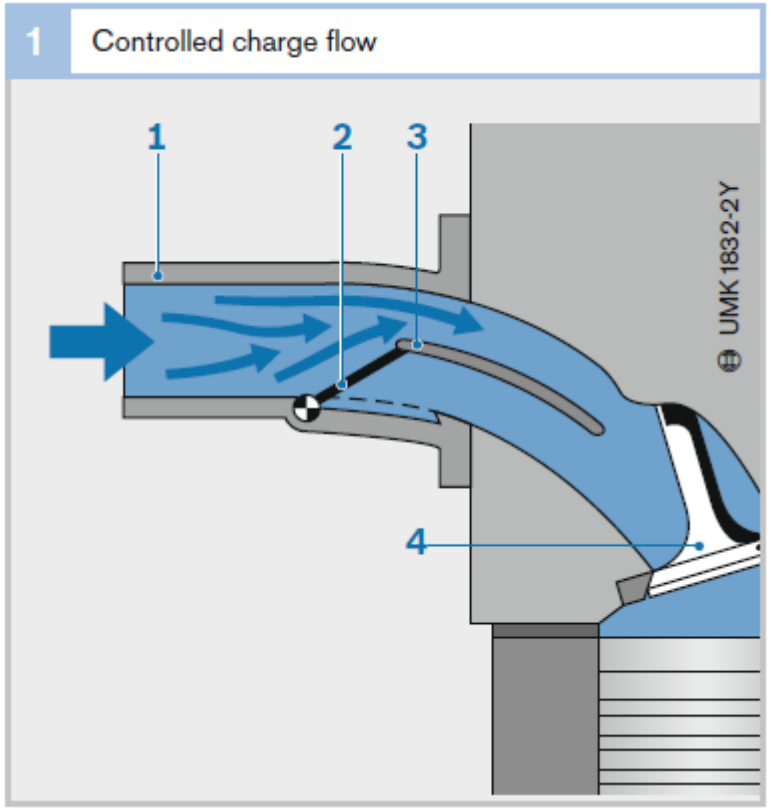


Fig. 1

1 Intake manifold
2 Charge-flow control valve
3 Separating ridge
4 Intake valve

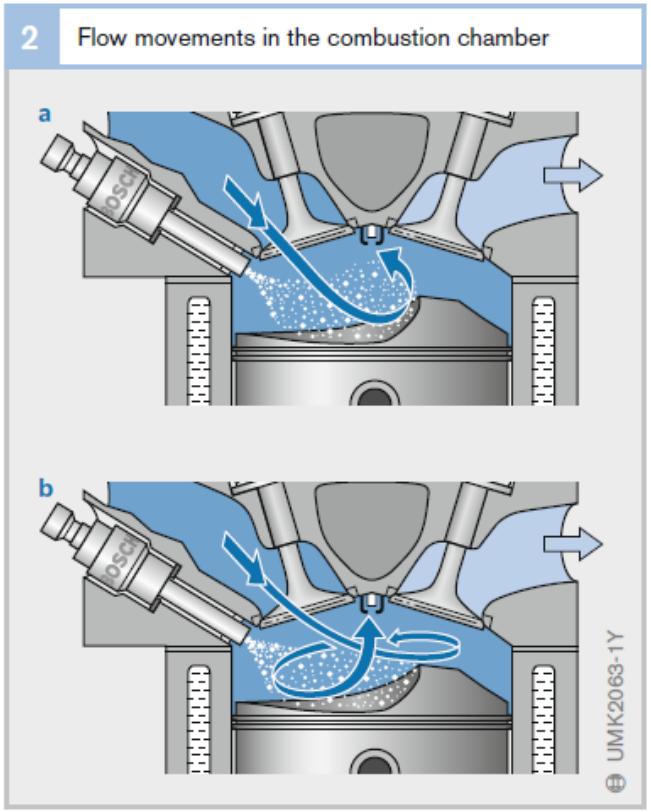


Fig. 2

a Tumble
b Swirl

Ανακυκλοφορία Καυσερίου

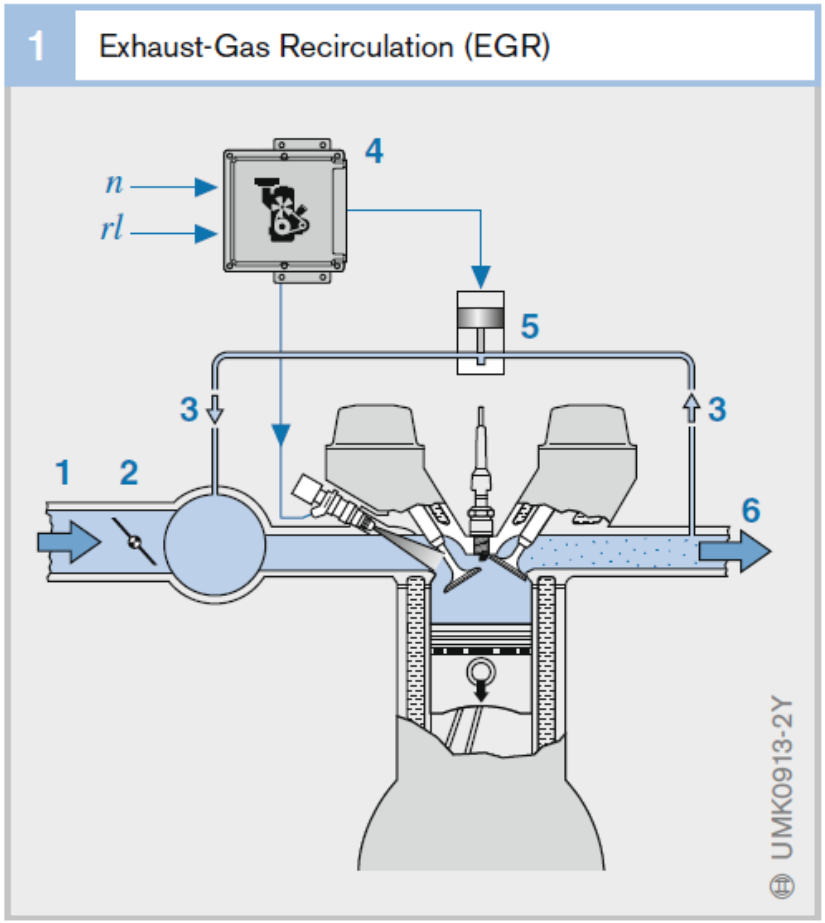


Fig. 1
1 Fresh-air intake
2 Throttle valve
3 Recirculated exhaust gas
4 Engine ECU
5 EGR valve
6 Exhaust gas

n Engine rpm
rl Relative air charge