DIESEL PARTICULATE FILTER REGENERATION CONTROL [SKYACTIV-D 2.2]

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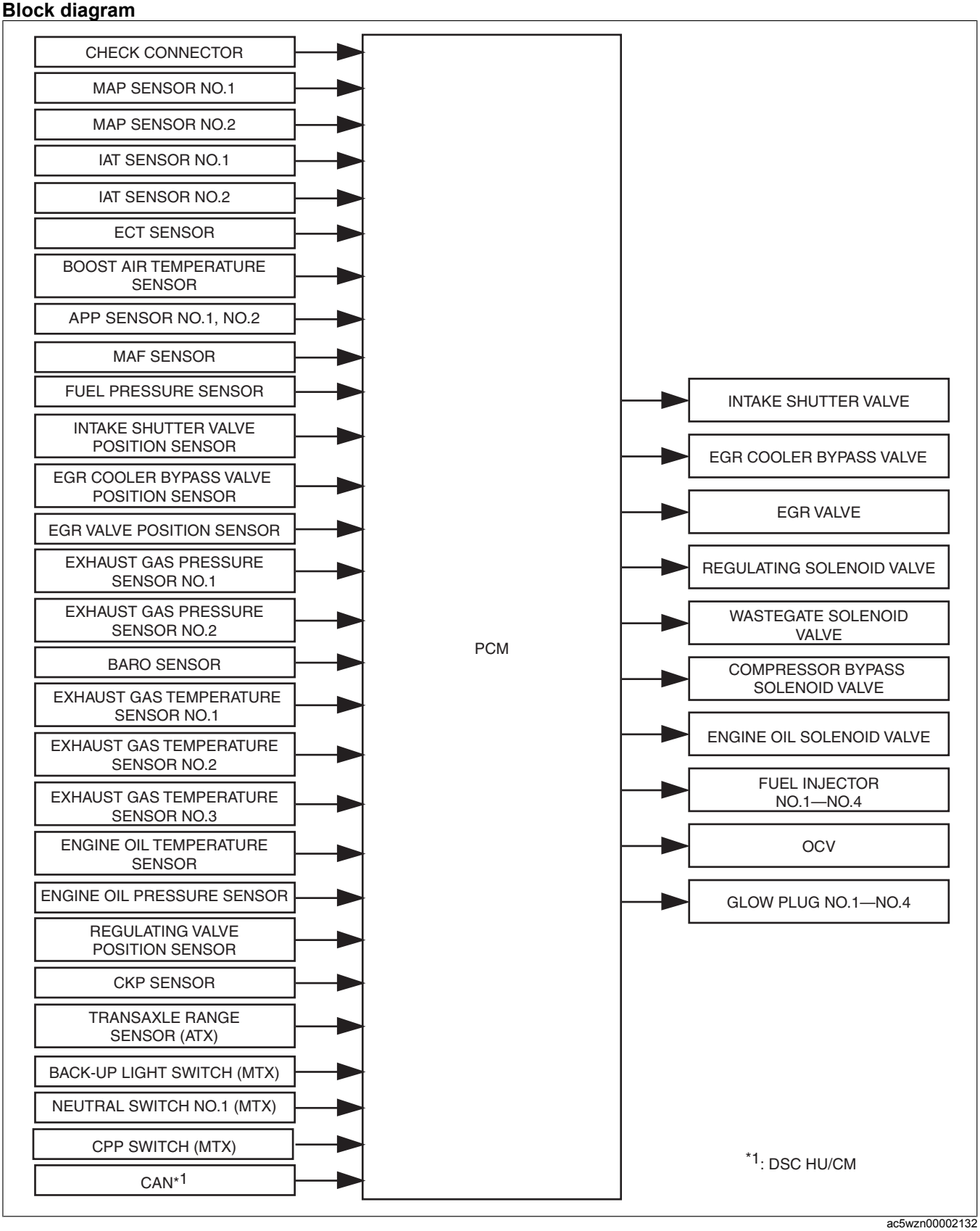
Outline

- When the amount of accumulated particulate matter (PM) in the DPF exceeds a certain value, the PCM controls to combust and eliminate PM.
- Two methods are available to combust and eliminate PM, one is automatic DPF regeneration control which is performed by the PCM automatically, and the other is compulsory DPF regeneration control which can be forcibly performed externally.

Block diagram



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Operation

- The PCM estimates the PM amount accumulated in the DPF.
- Amount of accumulated PM is calculated from the difference in exhaust gas pressures and PM emission amount.
  Estimation based on difference in exhaust gas pressures

- The amount of accumulated PM is estimated by comparing the exhaust gas pressures before and after the DPF based on the signals from the exhaust gas pressure sensor.

- The PM emission amount is calculated from the soot generation amount and the PM combustion amount.
  Soot generation amount
  - The soot generation amount is estimated based on the engine speed, intake air amount, and fuel injection amount.

  PM combustion amount
  - The PM combustion amount is estimated based on signals from the exhaust gas temperature sensor.
- The PCM illuminates/flashes the DPF indicator light and malfunction indicator light according to the amount of accumulated PM to promote DPF regeneration.

Item	DPF accumulation amount				
PM accumulation amount	0—8.0 g/L {0—0.50 lb/ft^3}	8.0—10.0 g/L {0.50—0.62 lb/ft^3}	10.0—13.0 g/L {0.62—0.81 lb/ft^3}	13.0—17.0 g/L {0.81—1.06 lb/ft^3}	17.0 g/L {1.06 lb/ft^3} or more
DPF indicator light	—	"Soot Accumulation in DPF too high"*1 (Informs user)	"DPF Inspection Required"*2 (Warns user)		
Check engine light	—	—	—	Illuminated*3 (Warns user)	
Output restriction	—	—	Gas temperature restriction	Gas temperature restriction and soot emission amount restriction	
DTC recorded in PCM	—	—	P2458:00	P2463:00	P242F:00
Automatic DPF regeneration control range	Automatic DPF regeneration control operable (If the accumulated PM amount exceeds the specified value*4, auto DPF regeneration control is implemented, and operates until the accumulated PM amount is approx. 0 g/L {0 lb/ft^3}.)		Automatic DPF regeneration control inoperable (Automatic DPF regeneration control is disabled when amount of accumulated PM is 10.0 g/L {0.62 lb/ft^3} or more because output is restricted)		
User action	—	Let vehicle warm-up completely and drive vehicle at 40 km/h or more for 10—20 min to promote efficient completion of auto DPF regeneration.	Bring vehicle to a Mazda dealer.		
Mazda dealer action	—	—	Compulsory DPF regeneration*5		DPF replacement

*1 : Turns off when it is 5.5 g/L {0.34 lb/ft^3} or less.

*2 : The DPF indicator light flashes when the amount of accumulated PM is 10.0 g/L {0.62 lb/ft^3} or more. This indicates that amount of accumulated PM in the DPF is full. Therefore, to reduce the amount of accumulated PM, the fuel injection amount is reduced and exhaust gas temperature restriction (output restriction) is performed. As a result, soot generation is reduced and the PM accumulating in the DPF is reduced. Turns off when it is 5.5 g/L {0.34 lb/ft^3} or less.

*3 : The malfunction indicator light illuminates when the amount of accumulated PM reaches 13.0 g/L {0.81 lb/ft^3} or more. In this case, to further restrict soot generation (output restriction), exhaust gas is induced to the cylinder by EGR control to lower the combustion temperature. As a result, soot generation is further reduced, and the PM accumulating in the DPF is reduced.

*4 : Figure fluctuates depending on distance travelled/conditions

*5 : The PCM automatically selects normal mode or long mode for the compulsory DPF regeneration operation time according to the accumulated PM amount. If compulsory DPF regeneration is performed when the amount of accumulated PM is less than 10.0 g/L {0.62 lb/ft^3}, normal mode is performed. If compulsory DPF regeneration is performed when the amount of accumulated PM is 10.0 g/L {0.62 lb/ft^3} or more, long mode is performed.

Automatic DPF regeneration control

- The PCM controls to combust and eliminate PM when the vehicle is driven for 10—20 min. with all the following conditions met.
  Automatic DPF regeneration control launch conditions
  - Engine completely warmed up (engine coolant temperature: 80 °C {176 °F} or more*1)
  - Vehicle speed: After 15 km/h {9.3 mph} or more reached (If traffic congestion determined, after reaching 5 km/h {3 mph} or more)
  - Accumulated PM amount: Specified value*2—10.0*3 g/L {0.62 lb/ft^3}

- After DPF regeneration control launches, it operates until the amount of accumulated PM amount lowers to approx. 0 g/L {0 lb/ft^3}.

*1 : If there is little frequency of complete engine warm-up, the lowest engine coolant temperature for launch is 40 °C {104 °F} or more.

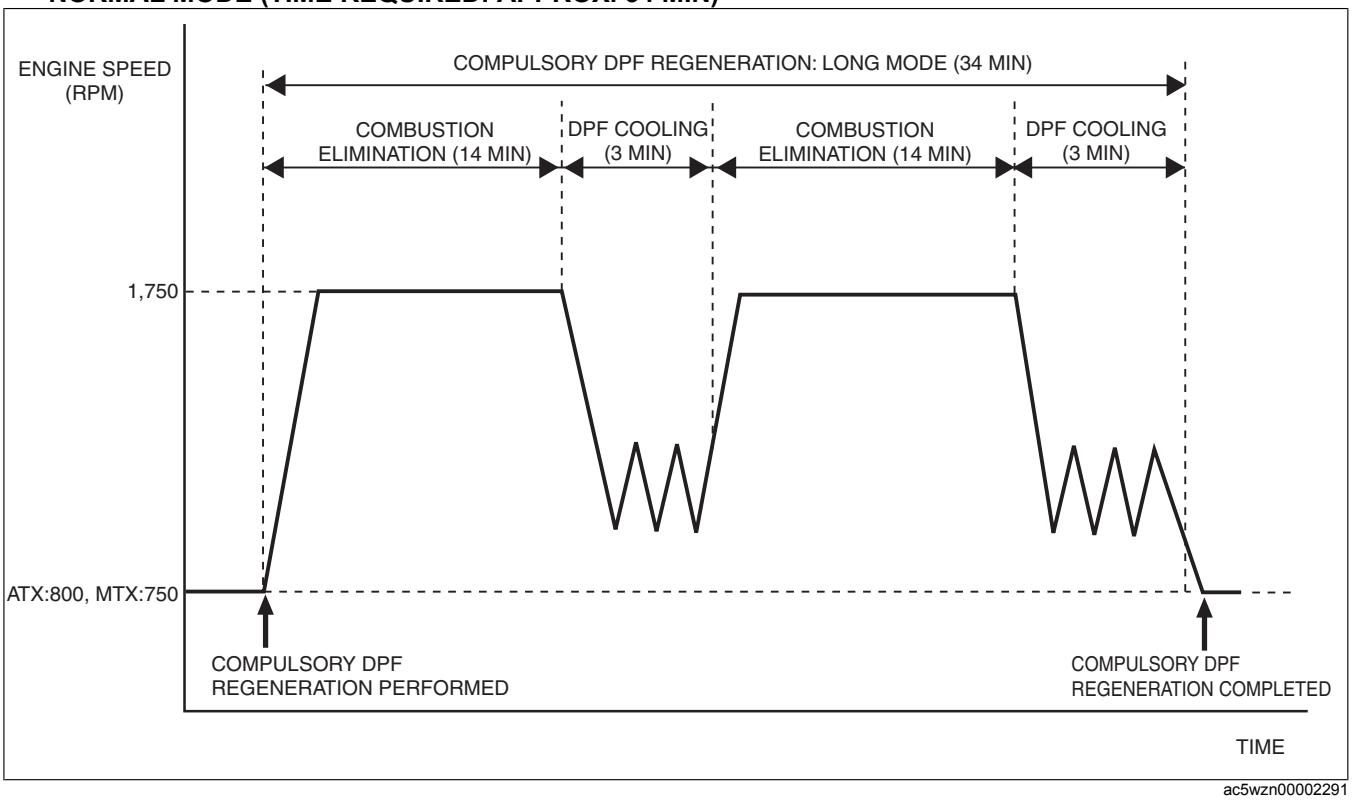
*2 : Figure fluctuates depending on the distance traveled /conditions.

*3 : If the accumulated PM amount reaches 10.0 g/L {0.62 lb/ft^3} or more, the output control is performed (reduction of PM exhaust amount and exhaust gas temperature), and auto DPF regeneration control is inhibited.

Compulsory DPF regeneration control

- Compulsory DPF regeneration can be performed using the Mazda Modular Diagnostic System (M-MDS).
- During compulsory DPF regeneration, idle speed is increased, and follow-up injection/post injection is performed to combust and to eliminate PM.
- The PCM automatically selects normal mode or long mode for the compulsory DPF regeneration operation time according to the accumulated PM amount.

NORMAL MODE (TIME REQUIRED: APPROX. 34 MIN)



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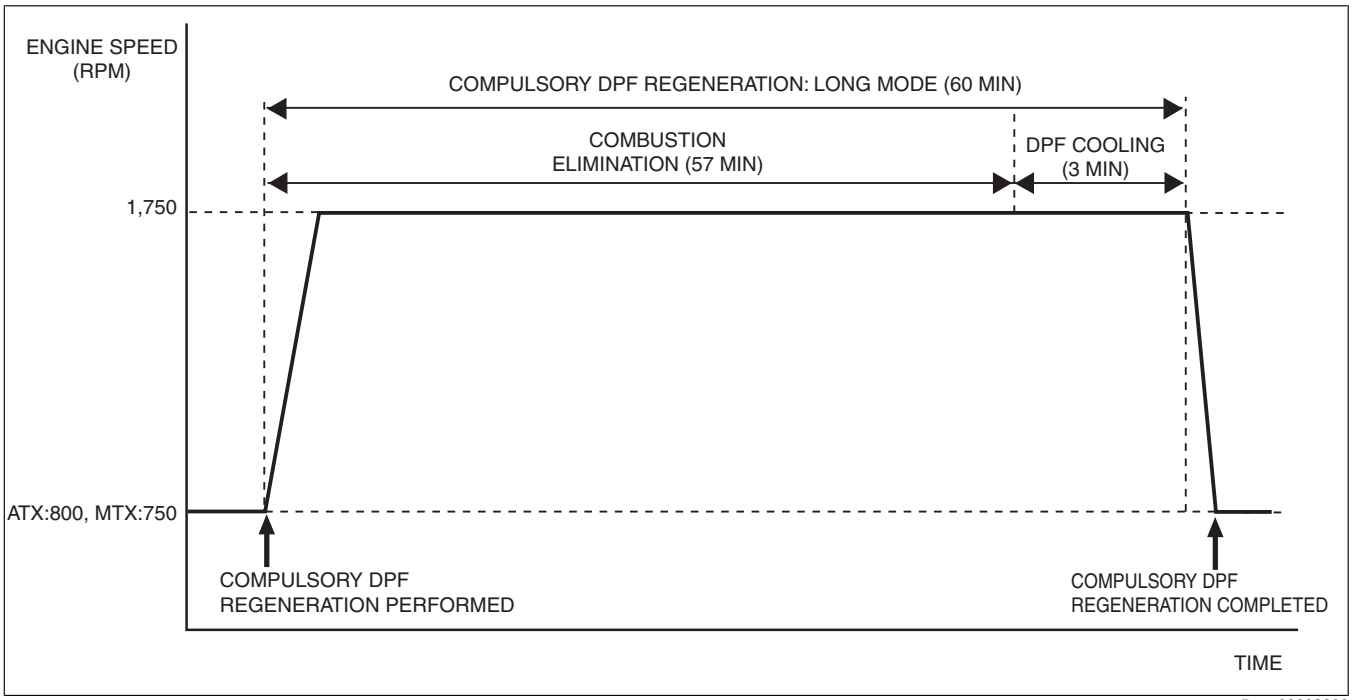
Implementation conditions

- Compulsory DPF regeneration is performed when amount of accumulated PM is less than 10.0 g/L {0.62 lb/ft^3}

Execution flow

1. Idle speed is maintained at 1,750 rpm for approx. 14 min to eliminate PM.
2. Idle speed is decreased and maintained for approx. 3 min to cool the DPF.
3. Idle speed is maintained at 1,750 rpm for approx. 14 min to eliminate PM again.
4. Idle speed is decreased and maintained for approx. 3 min to cool the DPF.
5. Idle speed is decreased to the normal idle speed and compulsory DPF regeneration is completed.

LONG MODE (TIME REQUIRED: APPROX. 60 MIN)



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Implementation conditions

- Compulsory DPF regeneration is performed when amount of accumulated PM is 10.0 g/L {0.62 lb/ft^3} or more

Execution flow

1. Idle speed is maintained at 1,750 rpm for approx. 57 min to eliminate PM.
2. The DPF is cooled by inhibiting the post injection for approx. 3 min with the idling engine speed fixed at 1,750 rpm.
3. Idle speed is decreased to the normal idle speed and compulsory DPF regeneration is completed.

- When the compulsory DPF regeneration procedure is performed, the PCM automatically selects normal mode or long mode according to the amount of accumulated PM. However, normal mode and long mode are not performed continuously. If compulsory DPF regeneration is performed once and the PM combustion elimination is not completed, it is necessary to perform the compulsory DPF regeneration procedure again.