

EGR CONTROL OPERATION [LF]

B3E014018881T30

Stepping motor operation principles

- The PCM opens/closes the EGR valve by controlling the amount of stepping motor rotation (step number).
- The stepping motor operates by the combination of coils No.1-4, according to the stepping motor step number.

Energization condition for each coil

ON: Energization OFF Non-energization

When current step number divided by four	Evenly divisible	One leftover	Two leftover	Three leftover
Coil No.1 (PCM terminal 2AU)	ON	ON	OFF	OFF
Coil No.2 (PCM terminal 2AR)	OFF	OFF	ON	ON
Coil No.3 (PCM terminal 2AY)	OFF	ON	ON	OFF
Coil No.4 (PCM terminal 2AV)	ON	OFF	OFF	ON

Example of energization condition for each coil and step number

ON: Energization, OFF Non-energization

Step number	0	1	2	3	4	5	6	7	8	9	10	30	52
Coil No.1 (PCM terminal 2AU)	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON
Coil No.2 (PCM terminal 2AR)	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF
Coil No.3 (PCM terminal 2AY)	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	ON	OFF
Coil No.4 (PCM terminal 2AV)	ON	OFF	OFF	ON	ON	OFF	OFF	ON	ON	OFF	OFF	OFF	ON

- The energization condition of stepping motor coils No.1-4 can be verified by verifying the step number from "SEGRP" on the PID/data monitor function of the WDS.

Control outline

- The PCM constantly calculates the optimum target EGR valve position according to the engine operation conditions and controls the EGR stepping motor step number so that the current EGR valve position is close to the target.
- If the current EGR valve position is smaller than the target EGR position (deviation is a positive number), the PCM increases the stepping motor step number and opens the EGR valve. If larger (deviation is a negative number), the PCM decreases the stepping motor step number and closes the EGR valve. Step numbers are increased or decreased by one step at a time.

Target EGR valve position

- The PCM determines the value to increase or decrease the EGR valve opening angle according to the engine operation conditions. The PCM determines the target EGR valve position through each correction based on the basic EGR valve position that is set according to the engine speed and load.

Target EGR valve position determination table

	Method for calculating or determining the EGR valve position
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Contents		and correction
Basic EGR valve position		Within steps 0-52 in the stepping motor determined as follows: • When the engine speed is 1,200-4,200 rpm and the charging efficiency* ¹ is within 12.5-75% , the engine speed and charging efficiency are determined to be at basic position • When the EGR control inhibition conditions are met, step 0
Correction * ²	Engine coolant temperature correction	Purpose: Improved driveability Engine coolant temperature is 50-55 °C {122-131 °F} • The step number is restricted between 0-50 % of the basic EGR valve position (low engine coolant temperature-low step number) according to the engine coolant temperature. Engine coolant temperature is 55-65 °C {131-149 °F} • The step number is restricted between 50-100 % of the basic EGR valve position (low engine coolant temperature→low step number) according to the engine coolant temperature.
	Intake air temperature correction	Purpose: Improved driveability Intake air temperature is 50 °C {122 °F} or less • Step number is restricted to 100 % of the basic EGR valve position (basic EGR valve position = step number) Intake air temperature is 50 °C {122 °F} or more • Step number is restricted between 40-100 % of basic EGR valve position (low intake air temperature→large step number)
	Acceleration/deceleration correction	Purpose: Improved driveability During acceleration/deceleration, when the throttle valve opening angle fluctuation rate is the set value or more • During acceleration→step number is restricted to 20 % of basic EGR valve position • During deceleration→step number is restricted to 0 % of basic EGR valve position

*¹ : The charging efficiency is the ratio of the actual amount of intake air to the maximum air charging amount (mass volume) of the cylinder. This value increases proportionately to the increase in engine load.

*² : The correction is to restrict the basic EGR valve position value. Except for the above conditions and inhibition conditions, the correction value is 100 %, and the target EGR valve position equals the EGR valve position value.

Inhibition conditions

• To improve driveability and ensure exhaust emission performance, the EGR valve closes when any of the following conditions are met. () indicate input/output devices.

- When throttle valve is fully closed (throttle position sensor)
- When vehicle is stopped (speed sensor)
- When the fuel injection control is in the high volume increase zone
- The engine coolant temperature is **50 °C {122 °F} or less** (engine coolant temperature sensor)
- During deceleration (throttle position sensor)
- Engine speed is **less than 1,200 rpm** or **more than 4,200 rpm** (crankshaft position sensor)
- Charging efficiency is **less than 12.5 %** or **more than 75 %** (crankshaft position sensor, mass airflow sensor)
- During traction control