

Development of a Brand New Hybrid Powertrain for C-segment SUV

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Nissan's unique 100% electrically driven hybrid system (hereafter referred to as e-POWER) is a fully motor-driven electric power system, where power is solely generated by the engine. This system can realize significant fuel economy in the vehicle class while maintaining a smooth acceleration and high level of quietness (EV-ness). This article introduces a hybrid powertrain newly developed for C-segment SUV, aiming at launching e-POWER into the global market.

The new e-POWER system was developed as a powertrain for C-segment SUVs, intended for the global market, to improve the smooth acceleration performance, quietness, and fuel economy, which are the characteristics of e-POWER.

To install the new e-POWER system into the C-segment SUVs intended for the global market, the driving force must be increased relative to the conventional e-POWER system. Therefore, the size of the motor has increased as it is the source of the driving power. Consequently, the engine output should be increased.

To achieve a higher engine output of the e-POWER system while maintaining the fuel consumption efficiency during fixed-point operation, this trade-off relationship must be resolved. Therefore, a newly developed 1.5 L 3-cylinder VC-TURBO engine has been adopted. the compression ratio of the VC-TURBO engine can be adjusted owing to the variable compression ratio mechanism. Consequently, a higher output with excellent combustion efficiency can be achieved by increasing the compression ratio in the non-supercharged area.

Nissan has defined the area where the engine noise is perceptible to the driver and optimized the engine start conditions to prevent the engine from starting in this area such that the engine start noise is imperceptible to the driver, and a quiet driving can be achieved. the number of engine-starts decreased significantly in the low-speed range, compared with that of the conventional e-POWER system.

The VC-TURBO engine can generate a higher torque with low engine speed compared to the conventional naturally aspirated engine. Hence, an equivalent output can be generated with lower engine speed, thus enabling lower engine speed during the fixed-point operation of the engine. the e-POWER system requires fewer engine speed than the previous compact car models from the low-speed (where the ambient noise is low) to high-speed range. Hence, Nissan achieved lower engine noise levels, even during engine operation.

Owing to the high driving force achieved by the new motor of the newly developed e-POWER system and the high power output generated by the VC-TURBO engine, an acceleration performance surpassing conventional hybrid vehicles was achieved. the e-POWER system achieved a faster startup to reach acceleration G, immediately after standstill, thus achieving excellent responsiveness. In addition, the high acceleration G was maintained, thus, achieving a high acceleration performance compared to conventional hybrid vehicle.

During acceleration, the driver feels a sense of acceleration not only from acceleration G, but also from the engine noise. Therefore, Nissan performed technical development for controlling the engine operation points based on the vehicle speed and accelerator opening such that the driver can feel a satisfying sense of acceleration from the noise of the engine performing the power generation.

In the e-POWER system, the engine and drive axles are not connected mechanically. Therefore, flexibility of the engine operation points is high, and the engine start time can be independently selected. The frequency of operating the engine at the point of the best fuel consumption rate increased. Hence, a significant fuel economy has been achieved in the WLTC mode for vehicle classes, 4WD (18.4 km/L) and 2WD (19.7 km/L).



Fig.1 Appearance of the new hybrid powertrain