Development of new automatic transmission “SKYACTIV-drive” with dynamic and environmental performance

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1. Overview

Due to the appearance of HEVs and electric vehicles, the performance of base technology (such as engine, transmission and body) as well as the performance of electric device needs to be considered in vehicle performance. On the other hand, Mazda offers “fun to drive” and “significant environmental/safety performance” to all customers without depending on these eco-friendly vehicles. To reduce CO2/fuel consumption, we developed new automatic transmission, “SKYACTIV-Drive”. By installing this transmission in CX-5(SUV), Mazda3 and Mazda6 (sedan/wagon), smooth and powerful start, direct feel for fun to drive, BIC-level CO2 emission and fuel consumption were achieved.

2. Technology details

The technology concept of SKYACIV-Drive is shown in Fig.1. According to the analysis of overall transmission loss, we found out torque converter highly contributes to the loss. To reduce slippage of torque converter when driving, we set our goal to achieve full range lockup. However, booming noise and acceleration/deceleration shock are the obstacles to achieve full range lockup. To overcome these obstacles, we developed Full Range Direct Drive shown in Fig.2. Full Range Direct Drive can 1) reduce vibration with damper, 2) improve durability of lockup clutch and 3) downsize the torus. By reducing damper stiffness by 46% compared to previous transmission, damping performance was significantly improved. Judder caused by degraded clutch must be also prevented. By using the world’s first wet type single-sided multi segment friction plates in the transmission, cooling performance was improved by approx. 50% compared to previous transmission. Furthermore, using torque converter only at startup and optimizing oil flow enabled downsizing of transmission. As shown in Fig. 3, lockup range in JC08 mode was increased from 49% to 82%. To improve environmental performance as well as dynamic performance, both shift response and shock must be improved significantly. Accuracy in hydraulic control affects various mechanical parts and electronic parts. Therefore, as shown in Fig.4, we developed mechatronics module by integrating hydraulic circuit and electronic parts together. By storing output characteristics in the computer, variation in clutch hydraulic pressure was reduced to 1/5. Due to the introduction of this technology, fuel economy was improved by 4 to 7% compared to previous transmission and direct feel and BIC shift response were achieved.

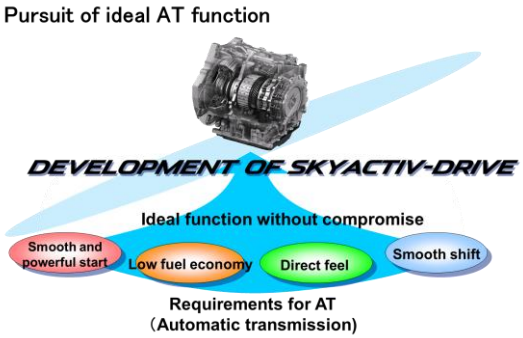

Fig.1 SKYACTIV-Drive technology concept

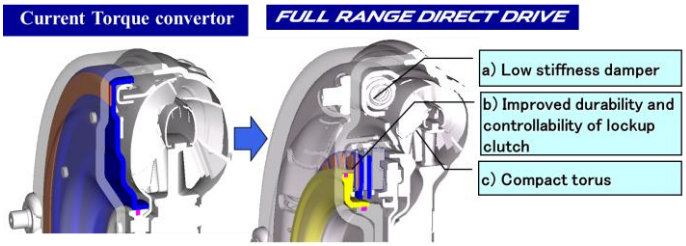

Fig.2 Full Range Direct Drive

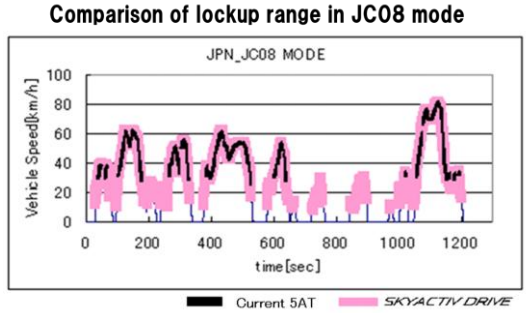

Fig.3 Lockup range

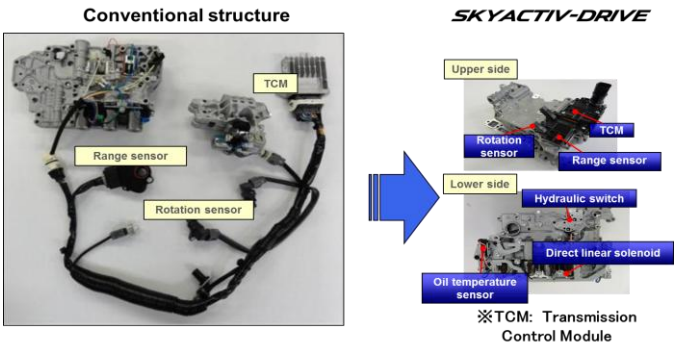

Fig.4 Mechatronics Module

3. Summary

SKYACTIV-Drive is installed in our flagship models and offers excellent “dynamic performance” and “environmental performance”. Even in the manual transmission dominating market, percentage of the automatic transmission share was increased by approx. 30%. This technology highly contributes to CO2 reduction.