

Quantum shifters

Electronic technology is improving fuel economy in heavy-duty automatic transmissions, finds Richard Simpson

Fuel economy was not a driver behind the original popularity of automatic transmissions in city buses. Indeed, with the fuel duty rebate equalling the gross profit in some bus companies, it was probably not even a consideration here in the UK.

All that has changed, of course, and with pressure on public transport to provide leadership in reducing both local pollution and global carbon emissions, fuel consumption has transformed from being an unavoidable overhead for bus operators into a factor to be measured, managed and reduced year-on-year. It has become a key performance indicator of environmental responsibility.

This has not passed unnoticed among transmission manufacturers. Alongside the previous objectives of supplying an easy experience for the driver and a comfortable ride for passengers, they are now focused on reducing fuel consumption without compromising either of the above. The advent of ever-more-powerful data processing capacity gives manufacturers an additional means of improving the operational efficiency of automatic transmissions that works hand-in-hand with mechanical developments.

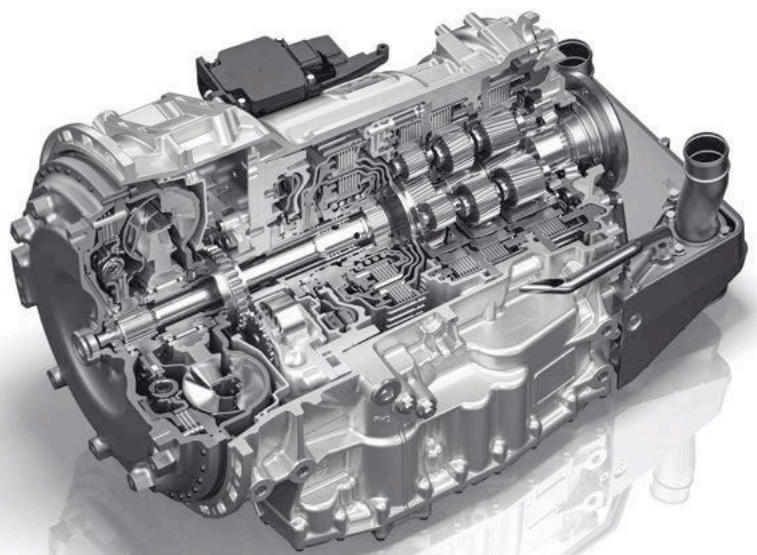
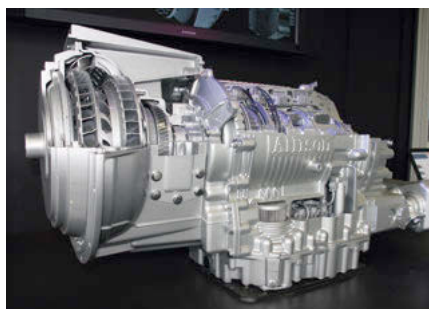
While heavy truck operators are growing accustomed to their automated manual transmissions using GPS and topographic mapping to choose suitable shift strategies for undulating

routes, bus operators have enjoyed the evolving benefits of simpler sensor-based systems for the past eight years or so.

SOFTWARE SELECTION

Allison offers Fuelsense 2 to the passenger, refuse and distribution sectors on its automatic transmissions (pictured below). That is a software package designed to optimise ratio choice and performance during acceleration, cruise, deceleration and stop modes, while Voith's DIWA bus transmission has a similar offering in its SensoTop package. ZF uses TopoDyn Life on its EcoLife automatic (pictured above), which measures resistance from incline and load and selects ratios to suit.

John Domigan, sales and marketing manager at Voith says: "SensoTop uses internal inclinometers to map terrain and adapt the shift programme accordingly in the DIWA automatic city bus transmission [pictured, p22]. This measures the incline and selects the appropriate gear ratios to ensure the



engine is producing the torque required.

"Operators can also specify acceleration limitation for the vehicle, if required. It's a generic programme, but with operator-specific parameters.

"Most of the transmissions we supply to the bus manufacturers have SensoTop installed, but we can also retune an individual bus to suit a particular requirement for a city or route." A bus that was, for example, operating in a flat city like Peterborough, could be retuned to optimise its performance if it were moved to a hilly city like Sheffield. "It's not a substitute for having a correct drive axle ratio, though," he cautions.

SensoTop requires no maintenance, and fuel savings generated by SensoTop can range from seven percent in very hilly terrain to two percent in flatter cities. This can be further boosted by an engine stop-start system, which shuts down the bus engine when the vehicle stops and the doors open.

ALMOST STANDARD

"This first appeared in 2015-16, and National Express took two demonstrators to trial the system in Birmingham," Domigan recalls. "An order for 90 vehicles followed. It's now almost a standard system on ADL and Wright buses equipped with Voith transmissions, working with Cummins and Daimler engines. At the request of the OEMs, the system only works when the bus is stopped, brake applied, and bus doors opened, and the engine



restarts automatically to recharge the torque converter.” Fuel saving depends upon conditions, but the average is usually three percent.

Meanwhile, Allison’s FuelSense 2 calculates vehicle load and incline from various inputs, and is a dynamically adjusts with those factors, engine fuel maps and road speed sensors to provide an infinitely-variable combination of shift points, according to Nathan Wilson, UK account and market development manager at Allison Transmission. The previous iteration, FuelSense 1, was a table-based system with fixed points for upward and downward shifts.

A FuelSense 2 user “will notice the system will always try to be in the optimum gear for road speed and economy; the engine will stay in the green band for longer. The system also mitigates against heavy-footed driving-styles,” Wilson says.

He also points out that the FuelSense 1 feature, ‘neutral at stop’ is carried over – that reduces or eliminates transmission load when the vehicle is stationary. It also locks the output to help prevent rollback. He adds: “The driver will not be aware, but this eliminates a significant source of fuel consumption.”

While going uphill, the inclinometer will hold a lower ratio than would be engaged at the same speed on the flat, while downhill it will select a suitable ratio to afford optimum engine-braking, reducing foundation brake wear.

No extra hardware is installed with Fuelsense 2: it’s purely a software package, and Wilson claims some operators have achieved payback in under 15 weeks. “There’s no weight penalty or separate black box, and no extra maintenance requirement: it’s a software package only. In fact, it should reduce wear-and-tear on all driveline components.”

Installed on two Mercedes-Benz Econic RCVs operated by Fife Council, the software returned a fuel saving of eight percent (see link below).

SAVINGS OF 10%

ZF claimed fuel savings of between five and ten percent over its predecessor transmissions when it introduced the TopoDyn Life feature on its EcoLife 2 automatic transmission six years ago. Earlier EcoMat transmission would pre-select just one programme from ‘economy,’ ‘normal’, and ‘power’. A single stiff climb on a route would see the transmission permanently set in ‘power’ mode, even if this was only required for a very short part of the journey.

The first iterations of EcoLife featured TopoDyn, which would choose one of the three modes as appropriate for the grade (typically selecting ‘power’

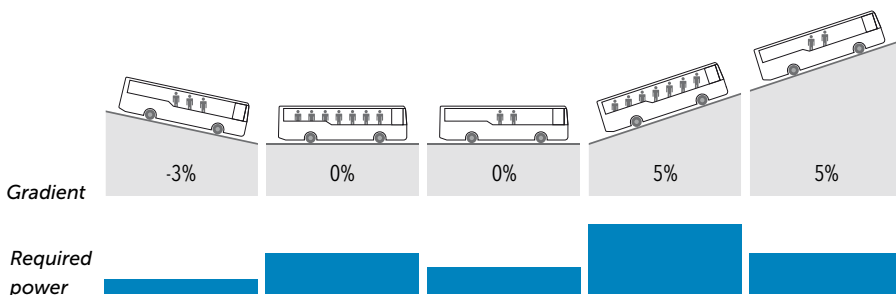
mode when grades reached four percent). TopoDyn Life moves from this essentially coarse digital process to constantly adjust shift characteristics with the vehicle on the move. Effectively, TopoDyn Life can choose from 100 or more different shifting strategies.

A change in incline is responded to within a distance of 10 metres, and the system also responds to changes in vehicle loading and even to the increased resistance caused by cornering. The transmission’s six speeds aim to keep engine speeds in the 950-1,300rpm band without constant ‘hunting’ between ratios, and if a constant speed is maintained on a flat road, then the transmission will select the appropriate ration to give the ideal 950rpm engine speed.

Another objective is the earliest possible mechanical lock-up to reduce parasitic losses within the transmission. There is also a ‘stop-start’ mode to decouple the transmission, and the vehicle can be slowed using the 6,000Nm integral retarder, with the transmission automatically selecting the lowest-possible gear to deliver the required effort.

A further economic and environmental benefit comes, ZF says, from the consequent reduced wear to the vehicle’s foundation brakes arising from the retarder taking most of the braking load. [IE](#)

Impact of load and gradient on power - Voith



FURTHER INFORMATION

CV axle ratios and why they matter - www.is.gd/opikoz

Council predicts £42,000 saving with FuelSense - www.is.gd/jehoru

Allison upgrade brings 12% fuel savings - www.is.gd/sjefu