UTIMATE
TRANSMISSIONS

The **Most Versatile, Lowest Parts Count** and **Cheapest Automated Transmission**

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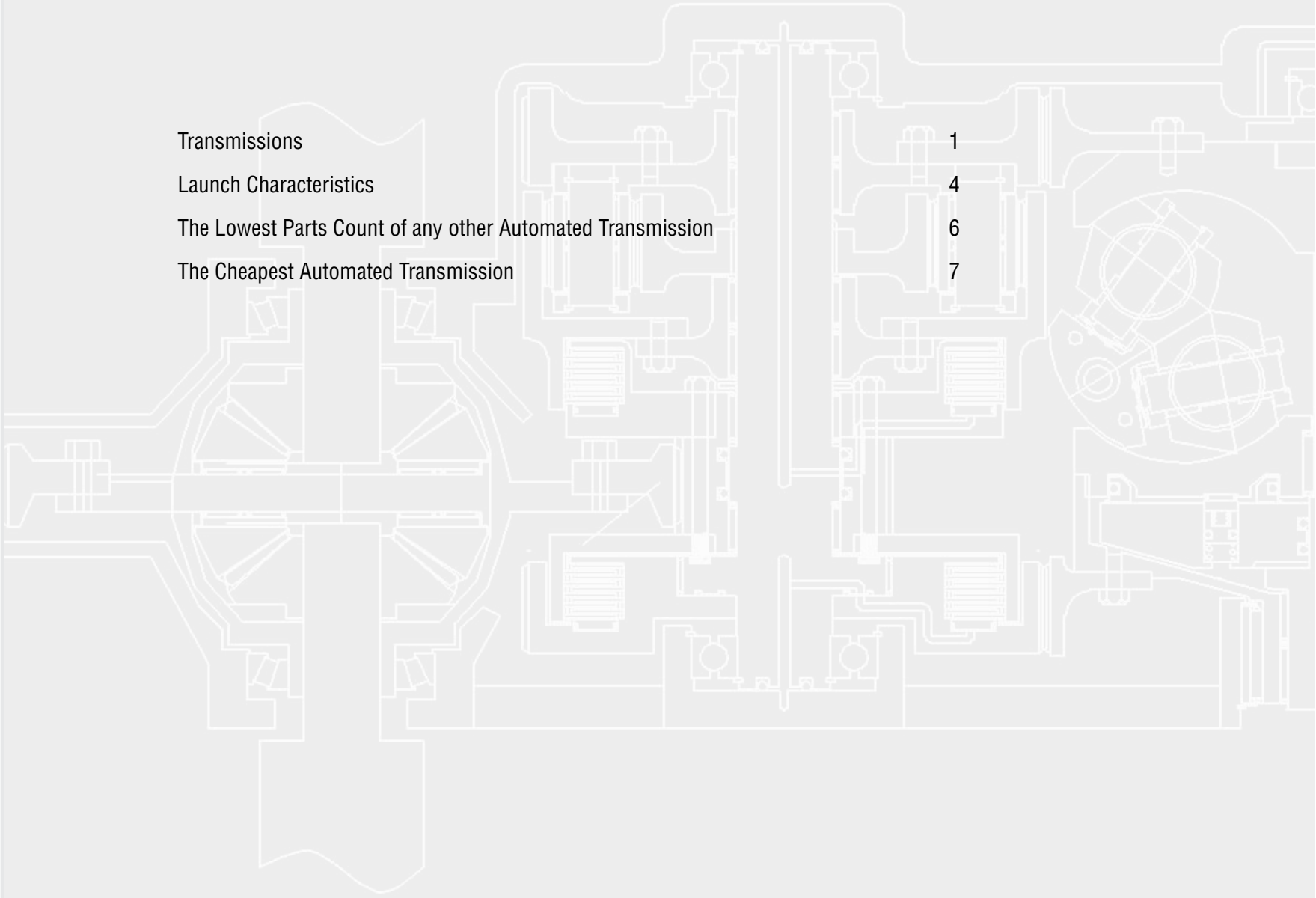


Transmissions

An IVT with geared neutral has the ability to move from reverse to neutral and then to forward motion without disconnecting the IC engine from the wheels. This makes it an extremely versatile transmission offering the vehicle operator, many options that are not available to non IVT transmissions.

DFTV - IVT OPERATIONAL OPTIONS

1. Extremely low gears with forward or reverse speeds as low as 2 meter a minute at 1,200 RPM.
2. “Dial-up” speeds that are controlled not by the accelerator pedal control of the IC engine but by a specific driver request.
3. Cruise control that is maintained using both IC engine speed and gear ratio.
4. Cruise control at very low speeds.
5. Different forms of “creep” and “hill holding” when in a near stopped state
6. Very high drive wheel torques at very low speeds with low engine RPM allowing for many innovative driver initiated maneuvers like curb mounting, and automatic parking.
7. Very high overdrive ratios typically 100kms/hour at 1,200RPM for gasoline and 1,000 RPM for diesel.
8. Very precise and versatile control of preferred fuel efficiency.

Transmissions

John Deere Tractors introduced IVT to some of their tractor range with almost instant uptake by farmers because of the versatility of the IVT concept, and the fuel savings associated with its operation.

Transmission, Infinitely Variable (IVT™) for 8030 Series Wheel Tractors Print

IVT cutaway

The revolutionary Infinitely Variable Transmission (IVT) provides excellent performance in all farming conditions. The John Deere IVT is an easy transmission to use, with simple and intuitive controls allowing you to move smoothly from 0.03 mph (50 meters/hr.) to 26 mph (42 km/hr.) and any speed in between. Never again is a gear too fast or too slow; the IVT provides a seamless range of speeds with no gaps. No clutching is required to start or stop the tractor. The footbrake with integrated AutoClutch performs like the brake in a car; simply depress both brakes and the transmission ratios down to a stop from any ground speed. To keep your 8030 Series tractor stationary even on inclines, use the John Deere-exclusive PowerZero™ feature. The 8030 Series IVT offers a choice of two control strategies: a right-hand reverser control (order code 1127) and a left-hand reverser control (order code 1137). The right-hand reverser control is optional on the 8130-8430 Wheel Tractors and base equipment on the 275 PTO hp 8530 Tractor. The left-hand reverser control is optional on all 8030 Series wheel tractors. The IVT is not available on the 8130 two-wheel-drive tractors or 8030 Series track tractors.

Extract from John Deere Web site http://salesmanual.deere.com/sales/salesmanual/en_NA/tractors/2006/feature/transmissions/8030_option_code_1127_1137_ivt_trans.html

Allison Transmissions are in the process of developing an IVT, for large commercial vehicles, using a Torotrak Variator to perform the CVT functions.

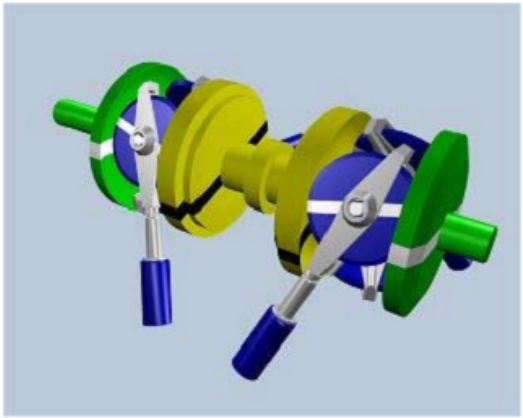
The bulkiness of the Torotrak CVT particularly when configured for a heavy duty work load, is not such a drawback in large commercial vehicles. The efficiency losses are also manageable by decreasing the crown radius of the rollers, and arranging the transmission with 3-4 ranges. Both of these design solutions increase the cost size and weight of the transmission beyond what would be acceptable for a normal passenger vehicle.

Allison Teams Up With Torotrak

Allison Infinitely Variable Transmissions (IVT)

Posted March 17 2009 03:53 PM by jason.thompson

Filed under: Diesel News, Diesel Observations



Imagine having your engine speed up while maintaining a crawl on a steep decline.

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Allison Transmissions Inc. (found behind the Duramax) has just signed a deal with a British company Torotrak. Torotrak specializes in CVT and IVT transmissions. Instead of using multiple gear ratios the IVT is torque controlled.

Extract from http://blogs.dieselpowermag.com/6469516/diesel-news/allison-infinitely-variable-transmissions-ivt/index.html

Launch Characteristics

a The behavior of a IVT during acceleration (in a passenger vehicle) is slightly different than that of a traditional automatic because of the internal inertia of the CVT and the efficiency of the CVT.

Torotrak have completed computer studies if the expected acceleration behavior of a SFTV based IVT using their S111 variator and their theoretical upgraded S111.

The efficiency of the Series 111 opt is expected (by Torotrak) to be around 4% more efficient than the Series 111 without optimization. The DFTV is always more efficient than the theoretical (perhaps unachievable) Torotrak Series 111 opt. by typically 2%.

Torotrak explain very clearly why an extra 4% loss of efficiency removes so much of the energy that should be going to the wheels during the initial acceleration phase. This removal of energy is associated with the recirculating power that occurs in an IVT which is most pronounced around the geared neutral point, combined with the normal inertia resistance of accelerating rotating masses.

When recirculating power is greater than the input power the losses are very great. However if the CVT is 100% efficient there is almost no loss. In the DFTV most of the recirculating power will occur around the 1:1 ratio where the CVT contact efficiency of a DFTV is around 99%.

In an AT these losses also exist within the torque convertor.

Extracts above and below from SAE paper 2003-01-0971 "Powertrain Efficiency Optimization of the Torotrak Infinitely variable Transmission (IVT)" Matthew Burke, Graham Briffet, John Fuller, Hubert Heumann & Jonathan Newell.

The Series III launch performance (distance after 4 s) could be dramatically improved and the optimised design is capable of exceeding the 4AT's performance by approximately 3 %. Other criteria, e.g. 0-100 kph and 80-120 kph time proved to be comparable to the 4 AT (Table 2). This shunt layout optimisation, made it possible for the Series III optimised IVT to match or even exceed the automatic vehicle's performance. This fact can also be observed by comparing the wheel torque profiles of the 4 AT and the optimised Series III in Figure 17.

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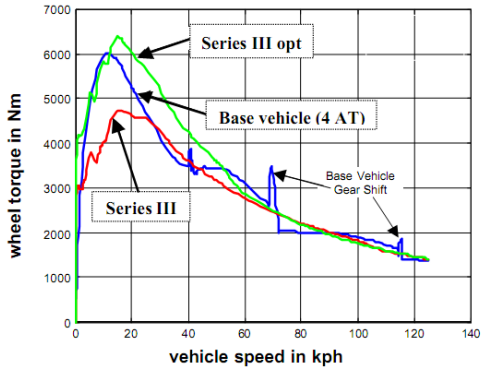


Figure 17: Wheel torque profile during wide open throttle acceleration (simulation)

Table 2: Performance results of the Series III/Series III opt compared to 4 AT

Performance Criteria	Series III	Series III opt
launch (distance after 4s)	-29%	+3%
0 – 100 km/h time	-6%	+2%
80 – 120 km/h time	-3%	0%

Series III

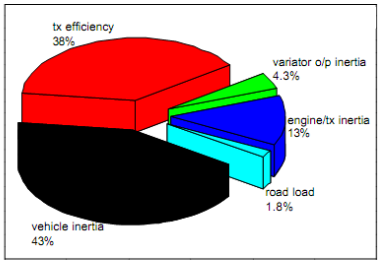


Figure 18a: Series III energy break-down (distance after 4s)

Series III optimised

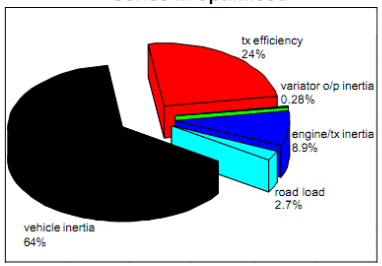


Figure 18b: Series III opt energy break-down (distance after 4s)

Launch Characteristics

It is possible for the DFTV based IVT to deliver more than 75% of the energy to the wheels making the beginning of the acceleration experience quite startling. It will be significantly more effective than that of a AT or even a well driven MT, using a slipping clutch.

This will mean that the DFTV based IVT will always out accelerate an AT up to around 40 k/hr.

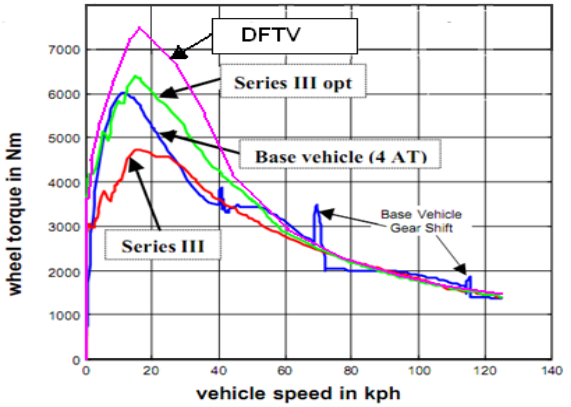
The maximum wheel torque (hill climbing) of the DFTV can always be much more than that of any other transmission, dependant on torque limits set by the design.

Ultimate Transmissions estimate the launching result of using a CVT with internal efficiencies around 3% higher than Torotrak's optimized S111 to be as follows.

The launch acceleration will improve significantly.

a A vehicle fitted with a DFTV - IVT will out accelerate a typical 4 speed automatic up to 40 km./hour by a significant amount. By the time the DFTV vehicle has travelled around 20 meters it will be a car length ahead of the4 speed AT.

The DFTV launch performance (Distance after 4 s) will be dramatically improved over the Torotrak S111 and optomised S111 making it as much as 25% greater than the compared 4AT. Other criteria such as 0-100kph will be reduced by around 8% with the 80 - 100 kph remaining the same.



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Wheel torque profile during wide open throttle acceleration (simulation)

Extracts above and below from SAE paper 2003-01-0971 "Powertrain Efficiency Optimization of the Torotrak Infinitely variable Transmission (IVT)" Matthew Burke, Graham Briffet, John Fuller, Hubert Heumann & Jonathan Newell.

The Lowest Parts Count of any other Automated Transmission

The parts count for a typical DFTV based IVT without the differential and electronics and hydraulic controls but including the ratio/torque actuators and hydraulics are in accordance with the following table.

Location	Individual part types	Individual parts
Body hydraulics and actuators	20	24
DFTV - CVT	40	210
IVT gears and clutches	45	190
TOTAL	105	424

NOTE hydraulic pumps, hydraulic control block, and actuator motors are counted as single parts

The greatest parts reduction occurs because of the absence of the fluid clutch. If counted as individual parts before assembly, a torque convertor contains more than 300 parts.

The belt drive CVT's utilize a belt or chain with over 600 parts

The transmissions using wet-plate clutches and one-way clutches very quickly amass 400 parts in these functions alone. Each planetary set requires around 50 parts.

A typical 4 speed automatic including the torque convertor will require over 700 parts.

A 6 speed DCT contains around 700 parts.

A 4 speed AMT may get close to 400 on parts count if compromises in drivability are accepted.

The Cheapest Automated Transmission

With a smaller mass and lower parts count the DFTV - IVT will be cheaper than all other forms of automatic transmission.

The key traction components of the CVT (rollers and discs) are made of expensive material and the processing costs of creating these parts are high. However all other parts, are similar to those parts found in conventional forms of automatic transmission, but there are quite simply less of them.

The actual weight of the “expensive parts” (rollers and discs) is 6 kg. in a 250Nm. transmission or around 15% of the overall mass.

The traction fluids are typically considerably more expensive than normal AT fluids with around 3 liters required for a 250Nm box.

The electronic and hydraulic controls for the DFTV-IVT will be similar to those of an AT although because of the transmissions versatility many control options will be possible outside the normal AT framework. These options may increase the cost above very standard automated transmissions, but will greatly improve the marketability.

www.ultimatetransmissions.com.au