

eMobility



EV Transmissions

Efficient technology for electric commercial vehicles

EATON

Powering Business Worldwide



Purpose-built electric design

Developed to aid efficiency, Eaton's portfolio of transmissions are helping to increase range, grade capability and acceleration for commercial EVs

Leveraging decades of experience building industry-leading commercial vehicle (CV) transmissions, Eaton's EV transmissions are based on proven, robust and efficient layshaft architecture typical of automated manual transmissions (AMTs), but they do not have a clutch and shifts are synchronized using the traction motor.

Unlike the direct-drive transmission that has long been the standard in EVs, Eaton's portfolio offers significantly greater efficiency at high speeds and increased torque at launch and low speeds.

The EV transmissions feature lightweight countershaft gearboxes that boast a range of torque capacities and electric gearshift actuation that allows for smaller electric motors.

The shifting strategy of the helical gears is controlled by the Transmission Control Unit, which ensures quick gear changes and maximum efficiency, extending EV battery range.

A deep-ratio first gear enables smooth launches under difficult conditions that would stress the driveline in other transmissions, while the gearbox's second gear is used to launch the vehicle under normal circumstances.

This setup enables a smooth launch on grades of up to 30%, compared with the approximately 10% grade limit of direct drives. On grades of between 5% and 7%, the transmission can maintain speeds of 80km/h (50mph), while at grades around 3% the system can hold steady at 95km/h (60mph).

Designed for 7- to 70-ton applications, the new transmissions provide a range of input speeds from 4000-6000rpm. The transmissions also improve acceleration by maintaining lower gears when possible, providing maximum motor power and efficiency at cruising speeds, and operating at higher speeds than traditional internal combustion engine transmissions. Additionally, gears are optimized for typical electric motor performance and power curves for maximum efficiency.

Road test results indicate Eaton's EV transmissions provide increased efficiency under normal driving conditions compared with a direct-drive transmission – delivering the right mix of efficiency and performance for electric commercial vehicles.



Eaton's new technology solves the primary issue related to direct-drive transmissions – providing high efficiency at top speeds and increased torque at launch and low speeds





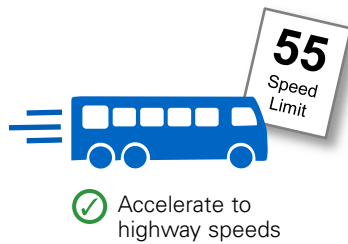
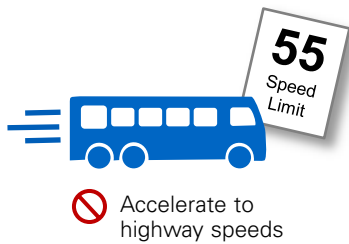
Why do EVs need transmissions?

Problem	Solution	Why it's Important
---------	----------	--------------------

Electric buses and trucks need to be able to:

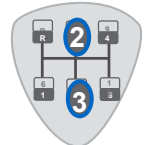
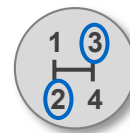
Expand the range of the motor by adding an EV transmission to the motor.

Eaton's history with hybrid systems (coordinating controls and systems) combined with our expertise with gear design and shifting technology enables us to help optimize electric vehicle performance.



4-Speed Electric

10-Speed Diesel

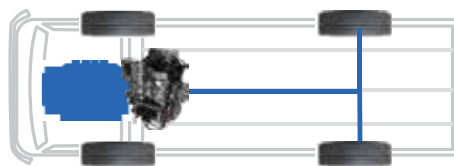


Most of the time

Very little time

Simple (but larger) motor...

Improved performance...



...sending power to the wheels

...may even allow a smaller, less expensive motor

Trucks and buses are heavy especially when full...and would need a very large and expensive motor.

Reliable & flexible performance

Eaton's proven EV transmissions improve performance on grades, allow motors to operate more efficiently, and improve top speed in a smaller and lighter overall package.

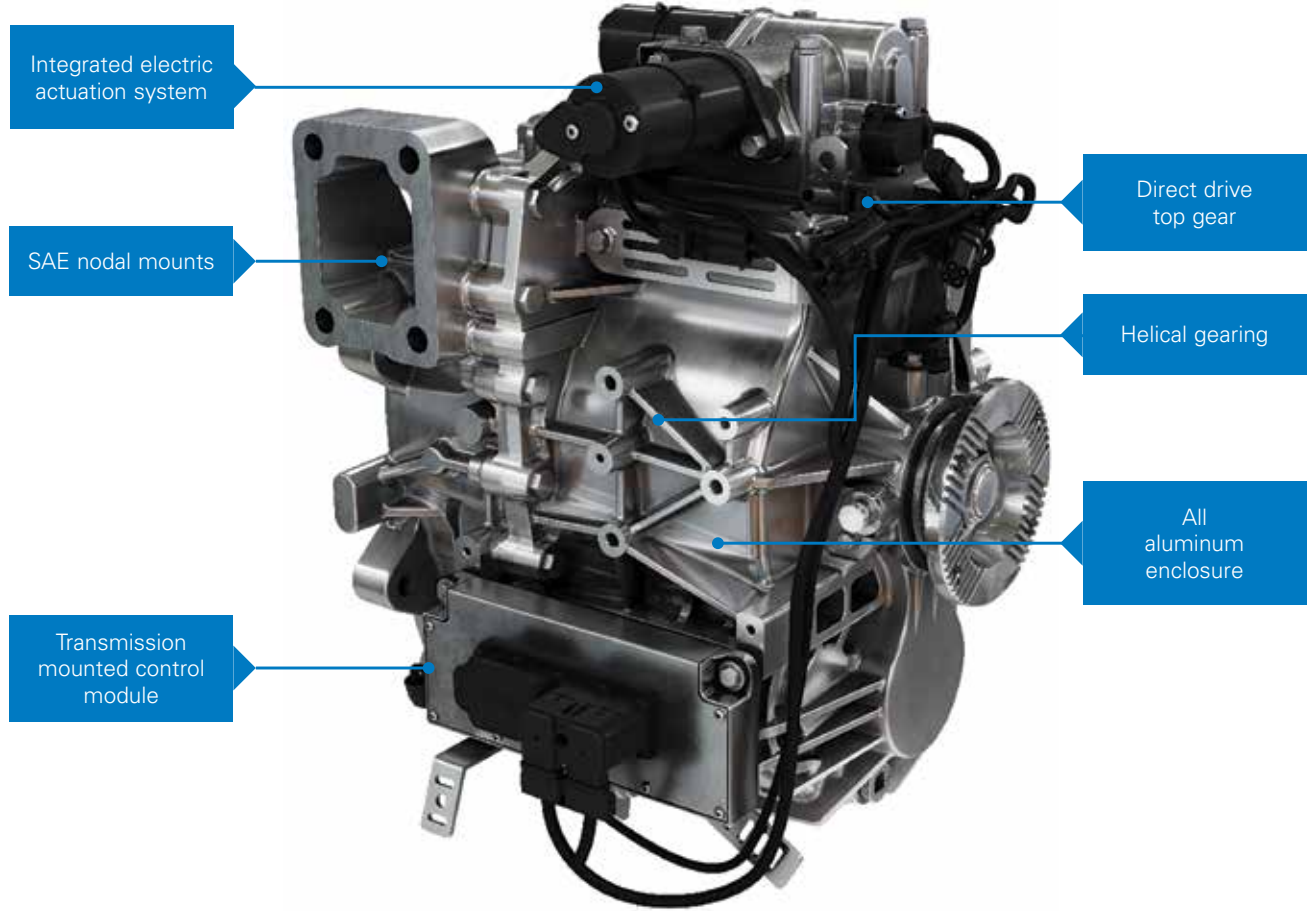


Eaton offers a variety of transmissions for electric trucks and buses. With over 15 years and 2 billion miles of safe, reliable xEV service, our transmissions deliver efficiency and performance required for the most challenging applications.

- **Efficient** motor use, extended range and/or reduced battery size
- **Improved performance** on grades, improved starting ability with a smaller motor, better acceleration
- **Tailored to your application** – bus, truck, variety of motor pairings, custom shift calibrations



EV Transmissions key features



	MD EV 2	MD EV 4	MD EV 6	HD EV 4** <i>Proof of concept</i>
# of forward speeds	2	4	6	4
EV	✓	✓	✓	✓
PHEV		✓	✓	
Housing	Aluminum	Aluminum	Cast iron	Aluminum
Max. Torque (Nm)	700	1200	1150	2600
Max. input speed (rpm)*	6000	5000 (EV) 2800 (PHEV)	4000 (EV) 2800 (HEV/PHEV)	5000
Typical GCW (tons)	18T	18T	27T	43T
Helical gearing	✓	✓	✓	✓
Smart gear selection		✓	✓	✓
Typical EV applications	Shuttle bus, school bus, city bus, logistics	City delivery, beverage, tourist bus, shuttle bus, school bus, city bus, logistics	City delivery, beverage, tourist bus, shuttle bus, school bus, yard tractor, municipal, city bus, logistics	Beverage, tourist bus, yard tractor, drayage, city dump truck, municipal, logistics

Note: *Max input speed vocation dependent. **Proof of concept model - final specifications may differ.

EV Transmissions key specifications & capacities

Medium duty 2-speed

Max. input speed	6000 rpm
Max. torque capacity	700 Nm
Dry weight	81 kg
Total length	582 mm
Oil capacity	4.6 liters
Maintenance intervals:	3 years, 300,000km (Bus/Vocational)

Ratio	1 st	2 nd	Overall
	3.529	1	3.529



Medium duty 4-speed

Max. power	kW
Max. input speed	5000 rpm
Max. torque capacity	1200 Nm
Dry weight	109 kg
Total length	420 mm
Oil capacity	7.3 liters
Maintenance intervals:	4 years, 300,000 km oil change

Ratio	1 st	2 nd	3 rd	4 th	Reverse	Overall
	4.83	2.82	1.65	1	4.57	4.83



Medium duty 6-speed

Max. input speed	4000 rpm (EV) 2800 rpm (HEV/PHEV)
Shift Controls	Eaton proprietary shift control logic
Max. torque capacity	1150 Nm
Dry weight	273 kg
Total length	590 mm (with SPL90 yoke)
Oil capacity	9.2 liters
PTO	6-bolt
Maintenance intervals:	3 years, 288,000 km oil change (Bus/Vocational)

Ratio	1 st	2 nd	3 rd	4 th	5 th	6 th	Reverse	Overall
	7.05	4.13	2.52	1.59	1	0.78	6.75	9.03



Heavy duty 4-speed* proof of concept

Max. input speed	5000 rpm
Shift Controls	Eaton proprietary shift control logic
Max. torque capacity	2600 Nm
Dry weight	TBD
Total length	TBD
Oil capacity	TBD
PTO	Rear PTO, option 8-bolt PTO
Maintenance intervals:	3 years, 400,000 km oil change (Bus/Vocational)

Ratio	1 st	2 nd	3 rd	4 th	Overall
	5.782	3.252	1.795	1	5.782

Note: *Proof of concept model - final specifications may differ.





Learn more about Eaton's transmissions
for electric commercial vehicles by
visiting [Eaton.com/eMobility](https://www.eaton.com/eMobility)

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
[Eaton.com](https://www.eaton.com)

© 2019 Eaton
All Rights Reserved
Printed in USA
Publication No. EMOB0003
October 2019

Eaton is a registered trademark.

All other trademarks are property
of their respective owners.

Follow us on social media to get the
latest product and support information.

