

# AxTrax 2

Electric Axle Solution for Commercial Vehicles



## ZF's Scalable and Modular e-Powertrain Platform

By leveraging a unique scalable and modular platform approach, with fully in-house developed key components, ZF is enabled as a single-source supplier to efficiently and expertly deliver a suite of e-Powertrain solutions to help OEM customers electrify commercial vehicle platforms.



Efficient.  
Integrated.  
Compact.  
Modular.

# Electric Axle Solutions

## AxTrax 2 and AxTrax 2 dual

ZF's range of e-Axles enable opportunities to reimagine commercial vehicle form, function, and architecture, enhancing packaging, enabling automation or adding battery capacity. Both models of AxTrax 2 are designed to replace the engine, transmission, driveline, differential and conventional axle to electrify commercial vehicles. The systems integrate in-house engineering and designed components into an innovative, unified, and compact axle-based solution. Both solutions are designed to fit into the space of the conventional axle, while providing high power and torque, at enhanced efficiency. Further providing ease of vehicle integration, the e-Powertrains offer harmonized in-house wheel-end brake solutions.

### AxTrax 2



- ▶ Integrates **single e-Motor, inverter, ECU, e-Actuator** and transmission
- ▶ Designed for a wide range of commercial vehicle vocations, from single axle to 6x4 and other multiple powered-axle applications
- ▶ Delivers 210 kw continuous power
- ▶ Provides 19,162 lb-ft of peak output torque

### AxTrax 2 dual



- ▶ Integrates **2 e-Motors, 2 inverters, ECU, 2 e-Actuators** and transmission
- ▶ Designed to serve heavy-duty commercial vehicles
- ▶ Delivers 380 kw continuous power
- ▶ Provides 40,418 lb-ft of peak output torque



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# EFFICIENCY

- ▶ Coaxial e-Axle design helps enhance overall efficiency
- ▶ Oil-cooled PSM hairpin eMotor technology
- ▶ High performance silicon carbide integrated inverter
- ▶ 3-speed integrated transmission
- ▶ Individual components carefully designed and harmonized to help maximize efficiency

## Advanced software helps maximize e-Powertrain system efficiency

### Optimized Transmission

- ▶ Dog clutch gear system
- ▶ Advanced efficiency maps for major driving duty cycles

### Smart Cooling and Lubrication

- ▶ Smart cooling strategy
- ▶ On-demand driven electric oil pump

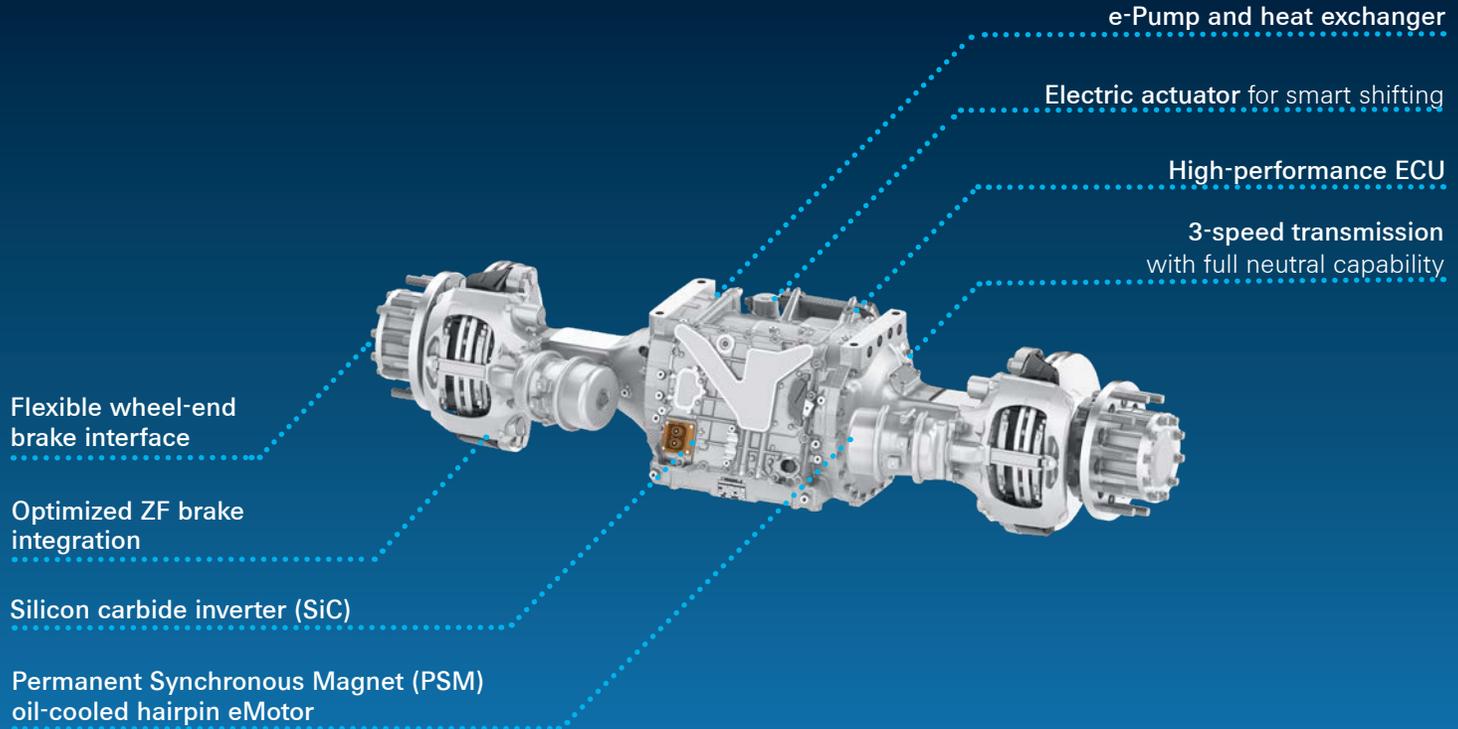
### Smart Shifting

AxTrax 2 dual and 6x4 applications

- ▶ No-skip shift strategy optimizes 6x4 dual e-Axle configuration, reducing speed loss and torque interruption during shifts
- ▶ The system times the shift for a smooth transition between gears
- ▶ Full neutral capability, enabling coasting operations and enhancing efficiencies

# AxTrax 2

## Electric Axle





# INTEGRATED SYSTEM

- ▶ Fully integrated e-Axle system: inverter, e-Axle control module, e-Actuator, heat exchanger, e-Pump and 3-speed transmission
- ▶ Easy to install with minimal interfaces to the vehicle:
  - ▶ The design reduces the overall installation effort at OEM assembly line
  - ▶ Eliminates external high voltage cables between the e-Motor and inverter
  - ▶ Eliminates heat exchanger lines to remote inverter
- ▶ System is ready to be integrated with common wheel end, brake, and suspension systems



# COMPACT

- ▶ Optimized Weight:
  - AxTrax 2: 1,410 lbs.
  - AxTrax 2 dual: 1,969 lbs.
- ▶ Coaxial e-Axle architecture enables increased power density
- ▶ Integration of major components eliminates unnecessary weight of remote accessories
- ▶ Compact design allows for increased battery space

Efficient. Integrated.  
Compact. Modular.



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# System Specifications

	AxTrax 2	AxTrax 2 dual
		
<b>Vehicle Config.</b>	Class 3-8	Class 8
<b>Voltage (nominal)</b>	650V (optional 750V)	
<b>GCVW</b>	Up to 42,000 lbs. (4x2 or 6x2) Up to 97,000 lbs. (6x4 or 8x4)	Up to 97,000 lbs.
<b>GAWR</b>	Up to 28,600 lbs. depending on application	
<b>Power</b> (Cont. / 30 min)	210 kW	380 kW
<b>Peak Power</b> (30 sec)	250 kW	450 kW
<b>Torque</b> (Cont. / 30 min)	~10,377 lb-ft	~22,385 lb-ft
<b>Peak Torque</b> (30 sec)	~19,161 lb-ft	~40,418 lb-ft
<b>System Weight</b> (excluding brakes & suspension)	~1,410 lbs.	~1,969 lbs.



# MODULARITY

- › **Vertical Scalability:** Trucks and Busses from Class 3 to 8
- › **Modularity:** e-Central Drives and e-Axles
- › **Global Availability:** US, Europe, and China

CLASS

3

4

5

6

7

8



Modular Solution for any OEM Global Vehicle Platform

# Modular e-Powertrain Platform

## Scalable Integrated In-House Components



**AxTrax 2**

42,000 lbs.  
210 kW



**AxTrax 2 dual**

97,000 lbs.  
380 kW



**CeTrax 2**

42,000 lbs.  
210 kW



**CeTrax 2 dual**

97,000 lbs.  
380 kW



**e-Motor**

EM300, EM400

1

One EM300

2

Two EM400

1

One EM300

2

Two EM400



**Silicon-Carbide  
inverter**

1

One

2

Two

1

One

2

Two



**Transmission**

3-speed

3-speed

3-speed

3-speed



**e-Actuator**

1

One

2

Two

2

Two

2

Two



**e-Drive Control Unit**

1

One

1

One

1

One

1

One

# Summary: The REAL Advantages

## Efficiency

- ▶ Coaxial e-Axle design helps enhance overall efficiency
- ▶ Oil-cooled PSM hairpin eMotor
- ▶ SiC inverter helps maximize efficiency
- ▶ Individual components carefully designed and harmonized to help maximize efficiency
- ▶ Advanced software supports e-Powertrain system efficiency
- ▶ Additional integration with ZF air disc brakes

## Compact

- ▶ Optimized weight:  
AxTrax 2: 1,410 lbs.  
AxTrax 2 dual: 1,969 lbs.
- ▶ Coaxial e-Axle architecture enables increased power density
- ▶ Integration of major components eliminates unnecessary weight of remote accessories

## Integrated System

- ▶ Fully integrated e-Axle system: inverter, e-Axle control module, e-Actuator, heat exchanger, e-Pump, and 3-speed transmission
- ▶ Eliminates heat exchanger lines to remote inverter
- ▶ An integrated inverter design eliminates external high voltage cables between the e-Motor and the inverter



## Capability

- ▶ Peak Power 500 kW (6x4)
- ▶ Sequential shift strategy in 6x4 application enhances system efficiency with no speed loss or torque interruption
- ▶ 3-speed transmission with powershifting for 6x4 configuration
- ▶ Enhanced shifting strategy
- ▶ Full neutral for towing and enabling efficiency during coasting and trailing



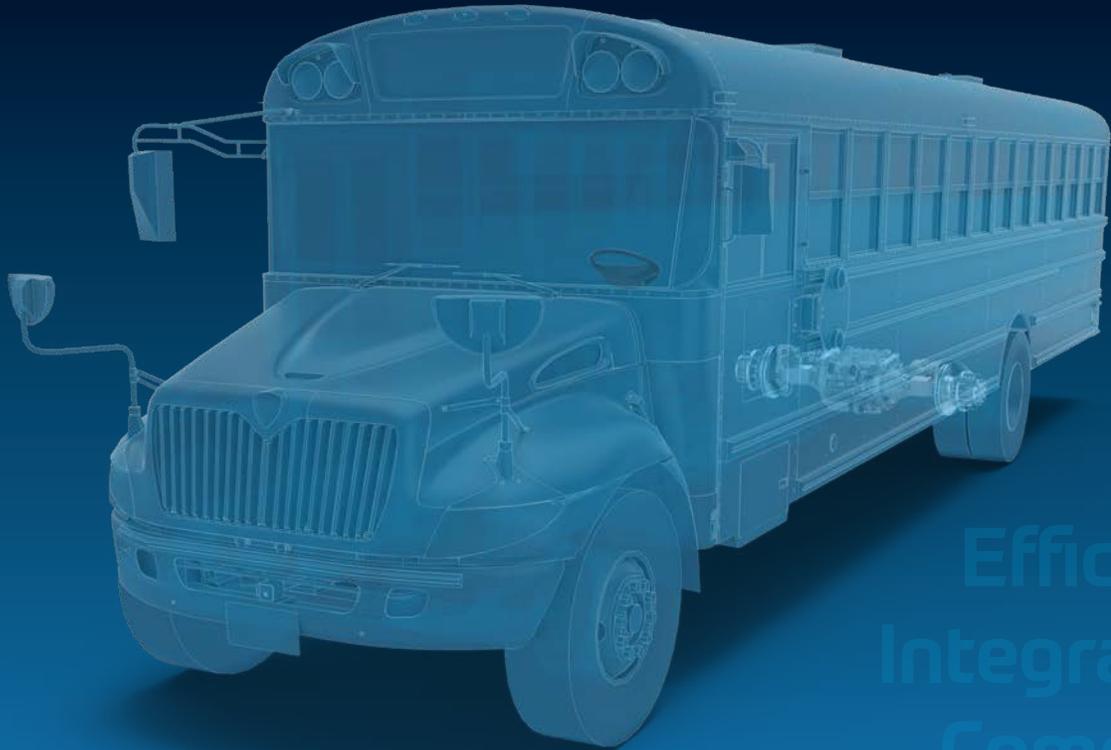
## Modularity

- ▶ Vertical Scalability:  
Trucks and Busses from Class 3 to 8
- ▶ Modularity:  
e-Central Drives and e-Axle architecture sharing main core components for easier serviceability
- ▶ Global Availability:  
US, Europe, and China



## Flexibility

- ▶ Flexible wheel end, brake, and suspension interface
- ▶ Easy to install with minimal interfaces to the vehicle
- ▶ Compact design allows for increased battery space



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**For further product details contact your sales representative.  
For more information on our product portfolio, visit: [zf.com/cv](https://zf.com/cv).  
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ZF is a global technology company supplying systems for passenger cars, commercial vehicles and industrial technology, enabling the next generation of mobility. ZF allows vehicles to see, think and act. In the four technology domains of Vehicle Motion Control, Integrated Safety, Automated Driving, and Electric Mobility, ZF offers comprehensive product and software solutions for established vehicle manufacturers and newly emerging transport and mobility service providers. ZF electrifies a wide range of vehicle types. With its products, the company contributes to reducing emissions, protecting the climate and enhancing safe mobility. With some 165,000 employees worldwide, ZF reported sales of €43.8 billion in fiscal 2022. The company operates 168 production locations in 32 countries.

ZF's Commercial Vehicle Solutions (CVS) division is helping shape the future of commercial transportation ecosystems. Our mission is to be the preferred global technology partner to the commercial vehicle industry. Powerfully combining ZF's commercial vehicle systems expertise, extensive technology portfolio and global operations, the division serves the full commercial vehicle industry value chain. As the automotive industry progresses towards an increasingly autonomous, connected, and electrified (ACE) future, ZF's CVS division innovates, integrates and supplies components and advanced control systems that help make commercial vehicles and fleets operate more safely and sustainably. CVS unites ZF's former Commercial Vehicle Technology and Commercial Vehicle Control Systems divisions, the latter being formed following ZF's acquisition of WABCO in Spring 2020.

