



ELECTRIC BUS

GVM ELECTRIC MOTORS DELIVER EFFICIENT PERFORMANCE AND COST SAVINGS TO LEADING ELECTRIC BUS MANUFACTURER

A Patented Cooling System and a Small Footprint Outperform the Competition

While developing its next generation of electric buses, a leading bus manufacturer, reevaluated every aspect of the existing design elements to uncover ways to improve power density, reduce packaging size and weight, lower noise emissions and increase system efficiency as well as improve passenger and driver elements.

From an engineering standpoint, the OEM believed that a redesign of its existing e-axles, inclusive of the gearbox and electric motor, could improve the overall efficiency of the bus while enhancing passenger comfort. The improved packaging and lower weight would also eliminate the need for large battery packs, which would positively impact load capacity.

The OEM wanted to optimize how the components interact as a whole to address current torque and efficiency shortcomings. The OEM's unique design includes high-capacity battery packs beneath the floor between the two axles, allowing for greater safety and increased stability with a lower center of gravity. This design limits the footprint of the gearbox due to it being mounted at the rear of the bus. With these engineering challenges, the OEM approached Parker engineers to design, develop

CHALLENGE:

While developing their next generation of electric buses, a leading bus manufacturer, reevaluated every aspect of the existing design elements to uncover ways to improve power density, reduce packaging size and weight, lower noise emissions and increase system efficiency as reduce noise for driver and passengers.

SOLUTION:

Parker's design included the integration of all electric components into the gear box: the electric motor, inverter, transmission, integrated cooling system and service brake. This high degree of integration reduced the number of interfaces to the vehicle and reduced the number of components and therefore, reducing footprint and weight.

BENEFITS:

Parker's GVM allowed the bus manufacturer to improve efficiency by more than two percent compared to the previous e-axle design in large part due to the reduction of battery size and weight. The GVM's unique thermal management system coupled with a greater range of flexible design options made it a smart electrification choice.

and test an enhanced electric motor for their e-axle solution.

A highly efficient power source for propelling electric vehicles, e-axles must be designed to go beyond providing torque and power to also balance performance, durability and reliability with maximum time on the road per charge.

Parker's engineers needed to look at both the system and component levels to find the optimal architecture. A fully-integrated e-axle, with all-electric drive (e-drive) components packaged together into the axle, allows for optimization of system weight and efficiency. However, integrating components into the axle can be challenging due to specific requirements based on (1) gross vehicle weight (2) application and (3) requested modularity.

Initially, the OEM was partnering with another supplier on the system, but there were issues. They sought alternative solutions from other manufacturers such as Parker.

Parker's engineers proposed a design that integrated all-electric components into the gearbox, including inverter, an electric motor, transmission, integrated cooling system and a service brake. This highly integrated solution reduced the number of interfaces to the vehicle and the number of components resulting in reduced footprint and weight.

The key element to this redesign included Parker's GVM electric motor. The GVM is scalable making it a good match for the small footprint. Parker engineers designed a smaller, more powerful solution with two GVM 310 motors with the shafts facing outward in a 125 mm stack compared to the initial manufacturer suggestion. The higher torque capacity of the GVM (173kW power @ max. 9000 rpm)



coupled with its innovative and patented thermal management system allowed the OEM to eliminate an oil cooling circuit that was previously required. The removal of the oil circuit, which included hoses and a radiator, helped make the design smaller, lighter and less complex which reduced the bill of materials for the vehicle.

Additionally, the GVM's patented cooling system ensures peak performance for longer periods of time by optimizing temperature for the power curve. There is a direct correlation between the coolness and continuous power; The cooler you keep the motor, the more power it delivers.

The GVM's comprehensive testing included verification that it meets and exceeds ISO 16750 in terms of shock and vibration at The Larson Transportation Institute's Bush Research and Testing Center along with efficiency tests at the Parker Motor Technology Center that confirmed to the OEM that this new e-axle would extend the length of the battery charge.

The OEM started with the idea of building a zero-emission

vehicle that could replace a standard diesel bus and reduce the transit industry's dependency on fossil fuels. Today, the OEM's electric buses have 20+ million service miles to date and have helped agencies avoid 130+ million pounds of CO2 emissions across the continent.

The range of an electric bus is the distance a bus can cover before running out of charge. How long this range is depends on a variety of factors, including battery size and duty cycles as well as the efficiency of the electric motor. Parker's GVM allowed the OEM to improve efficiency by more than two percent compared to the previous e-axle design. Furthermore, the GVM's unique thermal management system coupled with a greater range of flexible design options made it a smart electrification choice.

Parker's product engineers and systems solutions engineers exceeded the OEM's expectations throughout this project. The OEM and Parker are continuing to work together on future projects to bring more efficiencies and less environmental impact to municipalities across North America.

“ The GVM's design allowed us to shrink the footprint of the e-axle and reduce the size of the battery. The power range has increased to 7 extra miles per day.

-Leading Bus Manufacturer

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