Dura-Trac Advantages: Traction Applications

Category	***Dura-Trac Advantage Over Induction, Conventional Permanent-Magnet***
Efficiency Gains in Traction Applications	▪ **Continuously variable transmission**. Patented field weakening system for PM generator/motors allows range of torque / speed performance curves in same generator or motor. Functions as a magnetic CVT. ▪ **Thicker wire for reduced resistance**. Two DTM patents on a separate stator tooth design enable form wound stator coils that can use much thicker wire than conventional motor designs. The wire thickness can be 4-6 times thicker than the stator tooth slot. This greatly reduces stator coil resistance and I squared R losses for high efficiency. ▪ **Dura-Trac field weakening system** solves back EMF limits of permanent magnet generators and motors. ▪ **More effective field weakening**. DTM axial field weakening technology is much more efficient than controller-based methods that use stator coil energy to buck the rotor magnets and effectively weaken the rotor field. ▪ **Voltage adjustment**. In PM generators using DTM technology, dynamic changes in magnet rotor engagement adjusts the generated voltage. ▪ **Magnetic drag and overvoltage eliminated**. In parallel hybrid applications, total decoupling of rotor eliminates magnetic drag losses and overvoltage concerns when engine is moving the vehicle at highway speeds. ▪ **Wheel-hub motor**. Patent issued for wheel hub motor with magnetic field weakening. Wheel-hob motor enables "Skateboard" EV or fuel-cell vehicle to benefit from PM brushless motor efficiency and the wide dynamic speed range in a very compact package.
Durability	▪ **OEM testing**. Cummins engine product development system used to refine and validate the design for commercial vehicle hybrids. Cummins testing included accelerated life tests and six-month performance test. ▪ **Installed units**. 160+ motors / generators produced by licensee Crosspoint Kinetics for installation as retrofit hybrid in heavier-duty truck chassis. ▪ **10,000,000 miles**. Installed fleet has accumulated 10+ million fleet miles with no failure of motor. ▪ **DFM design**. Dura-Trac has received praise for the Design for Manufacturability (DFM). Radial and concentric magnetic air gap and rotor / shaft help ensure a durable and manufacturable generator or motor.
Packaging	▪ **Scalable length and width**. Dura-Trac motor/generator can be increased or decreased in length and width to accommodate different packaging requirements. Minimal tooling expense for modifying size. ▪ **Wheel-hub motor**. Allows many more vehicle packaging options with the benefits of the patented magnetic field weakening technology.
Multiple Energy Storage	**Batteries, super-capacitors, or both**. Because Dura-Trac system adjusts voltage, the system can operate effectively with batteries of any chemistry as well as supercapacitors. The retrofit hybrid-electric drive system was linked to supercapacitors, which eliminated the need for any off-board charging. Capacitors were recharged during braking. There are emerging technologies that allow batteries and supercapacitors to be used in tandem.