

SYNCHRO-SYM versus Koenigsegg Quark E-motor

Fred.klatt@bestelectricmachine.com

Publicized as the most advanced electric vehicle electric motor available, [Koenigsegg](#) recently introduced the [Quark E-motor](#) with a conventional electric motor circuit and control technology comprising the asymmetry of a “passive rotor with rare-earth permanent magnets” but with an unconventional composite structure. In contrast, SYNCHRO-SYM is a *patented* and *only* electric motor circuit and control technology that symmetrically makes the rotor real estate an “additional active” contributor to the electromechanical energy conversion process, along with the universally essential active stator real estate at any speed. Therefore by providing double the power density and octuple the peak torque at half the cost and loss of any other electric motor system with the same full load speed design, material, winding, manufacturing, thermal management, and packaging techniques, such as the Quark E-motor, [SYNCHRO-SYM](#) is the most optimum electric motor possible as was hypothesized by over a half century of classic electric motor study.

The following Table shows SYNCHRO-SYM’s leap in performance over the Quark E-motor:

Side by Side Comparison ¹	BEM SYNCHRO-SYM (Fully Integrated Motor System)	Koenigsegg Quark E-motor (Component Motor System)
Type	Fully Electromagnetic (Symmetric Synchronous) (Axial Flux Form)	Rare-earth Permanent Magnets (Asymmetric Synchronous) (Hybrid Radial-Axial Flux Form) ²
Electronic Controller Specification	Included in all SYNCHRO-SYM Specifications (Tightly Coupled System or an integrated Modular Motor System) (Controller rated for peak power)	≈ 13 in. x 12 in. x 5 in. 780 in ³ (12.8L) (External Component) (?)
Authentication	BEM-CAD ³ Prototype (Manufactured with <i>Conventional</i> Electric Motor Techniques under MOTORPRINTER)	Production Prototype (Manufactured with <i>Unconventional</i> Electric Motor Techniques)
Cost (Including Controller)	Request Pricing (1 st 1500 units) Request Pricing (Production)	\$ per unit (?) ? (?)
Effective Diameter	330 mm (12.97 in.) (Including Controller)	332 mm (13.1 in.) (Without Controller)
Effective Length	114 mm (4.5 in.) (Including Controller)	112 mm (4.4 in.) (Without Controller)
Weight	45 Kg (99 lb) (Including Controller)	28.5 Kg (63 lb) (Without Controller)
Motor Volume	9.7 Liters (592 in ³) (Including Controller)	8L (488 in ³) (Without Controller)
“System” Volume (Including Controller)	9.7 liters (592 in ³)	20.8L [= 8L + 12.8L] (1269 in ³)

Voltage	850V DC	850V DC
Full Load Speed ⁴	4000 RPM	4000 RPM
<i>Nominal Power</i>	70 KW (94 HP) <i>(Including Rated Electronic Control)</i>	100 KW (134 HP) (?)
<i>Nominal Torque</i>	167 Nm (123 ft-lb)	250 Nm (184 ft-lb)
<i>Nominal Efficiency</i>	97% <i>(Including Controller)</i>	? (?)
<i>Nominal Operating Time</i>	343 sec <i>(Including Controller)</i> (Standalone, Without Active Cooling, Ambient 50°C, ΔT 25°C)	? (?) (?)
	Continuous <i>(Including Controller)</i> (With 175 CFM air flow or 1.3 L/min Liquid flow)	? (?) (?)
<i>Nominal Specific Power</i>	1.56 KW/Kg @ 4000 RPM <i>(Including Controller)</i>	? (?)
<i>Nominal Power Density</i>	7.2 KW/L @ 4000 RPM <i>(Including Controller)</i>	? (?)
<i>Peak Power</i>	560 KW (751 HP) <i>(Including Rated Electronic Control)</i>	250 KW (335 HP) (?)
<i>Peak Torque</i>	1338 Nm (987 ft-lb)	600 Nm (443 ft-lb)
<i>Efficiency @ Peak Power</i>	83.5% <i>(Including Controller)</i>	? (?)
<i>Peak Power Operating Time</i>	8.6 sec <i>(Including Controller)</i> (Without Active Cooling, Ambient 50°C, ΔT 25°C)	20 sec (?) (?)
<i>Peak Specific Power</i>	12.5 KW/Kg @ 4000 RPM <i>(Including Controller)</i>	8.7 KW/Kg @? RPM <i>(Without Controller)</i>
<i>Peak Power Density</i>	58 KW/L @ 4000 RPM <i>(Including Controller)</i>	31.3 KW/L @? RPM <i>(Without Controller)</i>
<i>Direct Drive Tandem System⁵</i>	Adjacent SYNCHRO-SYMs <i>(Including Controller)</i>	Koenigsegg " Terrier Unit " (?)
<i>Weight</i>	90 Kg (198 lb)	85 Kg (187 lb)
<i>Dimensions</i>	340mm (Dia.) x 230 mm	340 mm x 475 mm x 425 mm
<i>Volume</i>	20L (1221 in ³)	40L (2441 in ³)
<i>Peak Power</i>	1120 KW (1502 HP)	500 KW (671 HP)
<i>Peak Torque</i>	2676 Nm (1974 ft-lb)	1200 Nm (886 ft-lb)
<i>Peak Power Density</i>	48.7 KW/L @ 4000 RPM	12.5 KW/L @ 4000 RPM
<p>¹ Without proprietary information, material, winding, manufacturing, thermal management, and packaging techniques are different, which favors unconventionally manufactured Quark-E.</p> <p>² Unconventional formfactor and rare earth permanent magnets complicates manufacturing</p> <p>³ BEM-CAD is Best Electric Machine's Computer Aided Design tool</p> <p>⁴ Constant Torque Speed Range, after which Constant Horsepower Speed Range</p> <p>⁵ Applied (or true) Power Density comparison by including the essential electronic controller</p>		