SYNCHRO-SYM versus Koenigsegg Quark E-motor

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Popularly considered to be 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 a "passive rotor of rare-earth permanent magnets" but with an unconventional composite structure. In contrast, SYNCHRO-SYM is a *patented* and the *only* electric motor circuit and control technology that uniquely 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)	≈ 13 in. x 12 in. x 5 in. 780 in^3 (12.8L) (External Component)
Authentication	BEM-CAD[3] Prototype (Manufactured with *Conventional* Electric Motor Techniques under MOTORPRINTER)	Production Prototype (Manufactured with *Unconventional* Electric Motor Techniques)
Cost	$33,000 per unit (*1st 1500 units*) $17,000 per unit (*Production*)	$92,000 per unit (*?*) ? (?)
Effective Diameter	12.97 in. (330 mm) (*Including* Controller)	13.1 in. (332 mm) (*Without* Controller)
Effective Length	5.31 in. (135 mm) (*Including* Controller)	4.4 in. (112 mm) (*Without* Controller)
Weight	48 Kg (*Including* Controller)	28.5 Kg (*Without* Controller)
Volume	11.5 Liters (*Including* Controller)	8L (*Without* Controller)
System Volume (*Including Controller*)	11.5 liters	8L + 12.8L = 20.8L

Voltage	850V DC	850V DC
Full Load Speed[4]	4000 RPM	4000 RPM
Nominal Power	70 KW	100 KW
Nominal Torque	167 Nm	250 Nm
Nominal Efficiency	97% (*Including* Controller)	? (?)
Nominal Operating Time	370 sec (*Including* Controller) (Without Active Cooling, Ambient 50°C, ΔT 25°C)	? (?) (?)
	Continuous (*Including* Controller) (With 175 CFM air flow or 1.3 L/min Liquid flow)	? (?) (?)
Nominal Specific Power	1.46 KW/Kg (*Including* Controller)	? (?)
Nominal Power Density	6.1 KW/L (*Including* Controller)	? (?)
Peak Power	560 KW	250 KW
Peak Torque	1338 Nm	600 Nm
Efficiency @ *Peak* Power	83% (*Including* Controller)	? (?)
Peak Power Operating Time	9.24 sec (*Including* Controller) (Without Active Cooling, Ambient 50°C, ΔT 25°C)	20 sec (?) (?)
Peak Specific Power	11.7 KW/Kg (*Including* Controller)	8.7 KW/Kg (*Without* Controller)
Peak Power Density	48.7 KW/L (*Including* Controller)	31.3 KW/L (*Without* Controller)
Direct Drive Tandem System[5] (*Including* Controller)	Adjacent SYNCHRO-SYMs	Koenigsegg "Terrier Unit"
Weight	96 Kg	85 Kg
Dimensions	340mm (Dia.) x 270 mm	340 mm x 475 mm x 425 mm
Volume	23L	40L
Peak Power	1120 KW	500 KW
Peak Torque	2676 Nm	1200 Nm
Peak Power Density	48.7 KW/L	12.5 KW/L

[1] Without proprietary information, material, winding, manufacturing, thermal management, and packaging techniques are different, which favors unconventionally manufactured Quark-E.
[2] Unconventional formfactor and rare earth permanent magnets complicates manufacturing
[3] BEM-CAD is Best Electric Machine's Computer Aided Design tool
[4] Constant Torque Speed Range, after which Constant Horsepower Speed Range
[5] Applied (or true) Power Density comparison by including the essential electronic controller