

SYNCHRO-SYM versus Koenigsegg Quark E-motor

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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 (RE-PM)” 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. As a result, [SYNCHRO-SYM](#) provides at least 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, 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:

Note: *The loss, size, and cost of the essential electronic controller is extraordinarily included in all SYNCHRO-SYM calculations because BRTEC is integral to its operation!*

Side by Side Comparison ¹	BEM SYNCHRO-SYM (Fully Integrated Motor System)	Koenigsegg Quark E-motor (Component Motor System)
Type	Fully Electromagnetic (no RE-PMs) (Symmetric Synchronous) (Axial Flux Form) (Rectangle Wire)	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. Additional 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 Rated Controller)	Estimate Retail Pricing ⁵ (1000 units) One year warranty Request Pricing (<i>Production</i>)	? ? ? ?
	\$8.7K (35KW Continuous Duty with 280KW peak)	\$13.1K (280KW Continuous Duty) \$ per unit (?) ? (?) ? (?)

<i>Effective Diameter</i>	297 mm (11.7 in.) <i>(Including Controller)</i>	332 mm (13.1 in.) <i>(Without Controller)</i>	
<i>Effective Length</i>	97 mm (4 in.) <i>(Including Controller)</i>	112 mm (4.4 in.) <i>(Without Controller)</i>	
<i>Weight</i>	29 Kg (63 lb.) <i>(Including Controller)</i>	28.5 Kg (63 lb.) <i>(Without Controller)</i>	
<i>Motor Volume</i>	<i>Not Applicable (fully integrated)</i>	8L (488 in ³) <i>(Without Controller)</i>	
<i>“System” Volume (Including Controller)</i>	6.7 liters (410 in ³) <i>(Including Controller)</i>	20.8L [= 8L + 12.8L] (1269 in ³)	
<i>Voltage</i>	850V DC	850V DC	
<i>Full Load Speed⁴</i>	2000 RPM	4000 RPM	
<i>Nominal Power</i>	35 KW (47 HP) <i>(Including Rated Electronic Control)</i>	280 KW (375 HP) <i>(Including Rated Electronic Control)</i>	100 KW (134 HP) (?)
<i>Nominal Torque</i>	167 Nm (123 ft-lb)	1340 Nm (990 ft-lb)	250 Nm (184 ft-lb)
<i>Nominal Efficiency</i>	97.5% <i>(Including Controller)</i>	81.3% <i>(Including Controller)</i>	? (?)
<i>Nominal Operating Time</i>	577 sec <i>(Including Controller)</i> (Without Active Cooling, Ambient 50°C, ΔT 25°C)	9.8 sec <i>(Including Controller)</i> (Without Active Cooling, Ambient 50°C, ΔT 25°C)	? (?) (?)
	Continuous <i>(Including Controller)</i> (With 68 CFM air flow or 0.5 L/min Liquid flow)	Continuous <i>(Including Controller)</i> (With 29 L/min Liquid flow – average garden hose flow rate)	? (?) (?)
<i>Nominal Specific Power</i>	1.2 KW/Kg @ 2000 RPM <i>(Including Controller)</i>	9.7 KW/Kg @ 2000 RPM <i>(Including Controller)</i>	? (?)
<i>Nominal Power Density</i>	5.2 KW/L @ 2000 RPM <i>(Including Controller)</i>	41.7 KW/L @ 2000 RPM <i>(Including Controller)</i>	? (?)
<i>Burst Peak Power</i>	280 KW (375 HP)	1120KW (1500 HP)	250 KW (335 HP)
<i>Burst Peak Torque</i>	1338 Nm (987 ft-lb)	5350 Nm (3947 ft-lb)	600 Nm (443 ft-lb)
<i>Burst Peak Power Operating Time</i>	9.8 sec <i>(Including Controller)</i>		20 sec (?) (?)

	(With 29 L/min Liquid flow – average garden hose flow rate)		
<i>Burst Peak Specific Power</i>	9.7 KW/Kg @ 2000 RPM (Including Controller)	38.8 KW/Kg @ 2000 RPM (Including Controller)	8.7 KW/Kg @? RPM (Without Controller)
<i>Burst Peak Power Density</i>	41.7 KW/L @ 2000 RPM (Including Controller)	168 KW/L @ 2000 RPM (Including Controller)	31.3 KW/L @? RPM (Without Controller)
Direct Drive Tandem System	Adjacent SYNCHRO-SYMs (Including Controllers)		Koenigsegg " Terrier Unit " (?)
Weight	58 Kg (126 lb.)		85 Kg (187 lb.)
Dimensions	297mm (Dia.) x 194 mm		340 mm x 475 mm x 425 mm
Volume	14L (820 in ³)		40L (2441 in ³)
Burst Peak Power	Double "Burst Peak Power"		500 KW (671 HP)
Burst Peak Torque	Double "Burst Peak Torque"		1200 Nm (886 ft-lb)
<p>¹ SYNCHRO-SYM specification from BEM-CAD and manufacturing with MOTORPRINTER. Quark E-Motor specifications and manufacturing unknown.</p> <p>² Unconventional formfactor, called raxial-flux, with rare earth permanent magnets complicating manufacturing. Koenigsegg says raxial-flux form is a radial-flux and axial-flux air-gap combination</p> <p>³ BEM-CAD is Best Electric Machine's Computer Aided Design tool</p> <p>⁴ Constant Torque Speed Range, sometimes called Maximum Load Speed, after which Constant Horsepower Speed Range. Koenigsegg is a motor manufacturer that gives a clear MLS for comparison.</p> <p>⁵ Liquid cooling system not included.</p>			