

SYNCHRO-SYM Airplane Electric Propulsion Systems

[Best Electric Machine \(BEM\)](#) is entering the Computer-Aided-Design (CAD) phase of developing a family of electric propulsion systems for electric airplanes that is based on its patented electric motor technology called [SYNCHRO-SYM](#), which is a symmetrical wound-rotor “synchronous” doubly-fed electric motor system circuit and control architecture as only provided by the highly integrated Brushless Real Time Emulation Controller (**BRTEC**). Starting with the SYNCHRO-SYM Airplane 250 (or SSA-250) electric motor product, the SYNCHRO-SYM family of electric airplane propulsion systems was formulated to compete with at least the [MAGNIX](#) Magni250, which was chosen because of its maturity. BEM does not consider the [HPDM-250 motor from HX3](#) as a competitive electric airplane propulsion system product because a) it must incorporate an electromechanical gearbox with obvious reliability, maintenance, and complexity issues and b) it provides a very high, top shaft power curve baseline of 5000 RPM that may be beyond conventional propeller capability but would show higher performance over an electric machine system reasonably running at half that speed (or 2000 RPM).

Unlike the [Magni250](#) specification, the SSA-250 specification:

- Provides an airplane propulsion system with a superior operating performance specification that always includes the efficiency, weight, and dimensions of the essential electronic controller, which for SYNCHRO-SYM is the highly integrated BRTEC;
- Provides an airplane propulsion system without rare-earth permanent magnets (such as neo permanent magnets) and their associated issues of cogging, cost, reliability, safety, life expectancy, and pollution;
- Provides a coaxial stack of two stand-alone (and replaceable) motors (with their own frame, electronic controller, and magnetic core) for continued operation (up to full power) should any one motor fail;
- Provides the advantages of [coaxial contra-propellers](#) for another level of air propulsion efficiency but without the reliability and maintenance issues of a complex gearbox but instead, by synchronously rotating the coaxial axles from the stand-alone motors in opposite directions, which provides a perfect balance of rotating inertia instead of the significant inertial unbalance of an engine or turbine rotating in a single direction;
- Broad variable speed of electric propulsion in conjunction with contra-propellers may also provide an alternative fly-by-wire propeller pitch control mechanism but without the mechanical complexity, maintenance, and reliability.

The following table provides the SSA-250 specification, which can be cross-compared with the [Magni250](#):

SSA-250 PERFORMANCE SPECIFICATIONS	
	<i>1) Contains No Permanent Magnets</i>
	<i>2) Dual Coaxial Stack of separately self-contained 140 KW Motor “Systems” provides Continuous 280 KW operation @</i>

		<p>2000RPM and continued operation with a single motor failure</p> <p>3) Dual Coaxial Stack of separately self-contained Motor Systems can be synchronized in opposite rotation (by electronic control) for <u>coaxial contra-props</u> without complex, high maintenance, and unreliable mechanical gearbox</p>
Continuous Torque	1337.6 N-M (986.6 ft-lb)	
Continuous Power	280 KW (375.2 hp)	Dual Coaxial Stack of separately self-contained 140 KW Motors provide Continuous 280 KW @ 2000RPM and operation with a single failure
Constant-Torque Speed Range	2000 RPM	
Maximum Speed	6000 RPM	
Peak Torque	2675.2 N-M (1973.2 ft-lb)	<p>23 seconds of operation Without Cooling, Rotor Locked</p> <p>Continuous operation with 48 L/M coolant flow</p>
Peak Power	560 KW (750.4 hp)	
Efficiency	>93%	
Motor "System" Weight	111.8 Kg (225.8 Lbs)	Unlike the anticipated weight of the Magni250 (without electronic control), SSA-250 includes Dual BRTEC and Dual Frames, Axles & Bearings
Motor "System" Diameter	356.9 mm (14.05 inches)	Unlike the anticipated Diameter of the Magni250 (without electronic control), SSA-250 includes Dual BRTEC and Dual Frames, Axles & Bearings
Motor "System" Length	304 mm (6in + 6in) (12 inches)	Unlike the anticipated Length of the Magni250 (without electronic control), SSA-250 includes Dual BRTEC and Dual Frames, Axles & Bearings
Motor "System" Volume	30.4 L	
Motor "System" Power Density (Continuous)	9.2 KW/L	Unlike the anticipated Length of the Magni250 (without electronic control), SSA-250 includes Dual BRTEC and Dual Frames, Axles & Bearings
Motor "System" Specific Power (Continuous)	2.5 KW/KG	
<p>Note: The frame and axle structure and strength were designed to accept an additional coaxial stack of motor systems for double the power (560KW of continuous power for the SSA-500), which will double the length and weight of the specification with four stand-alone 140KW SYNCHRO-SYMs instead of just two for SSA-250.</p>		