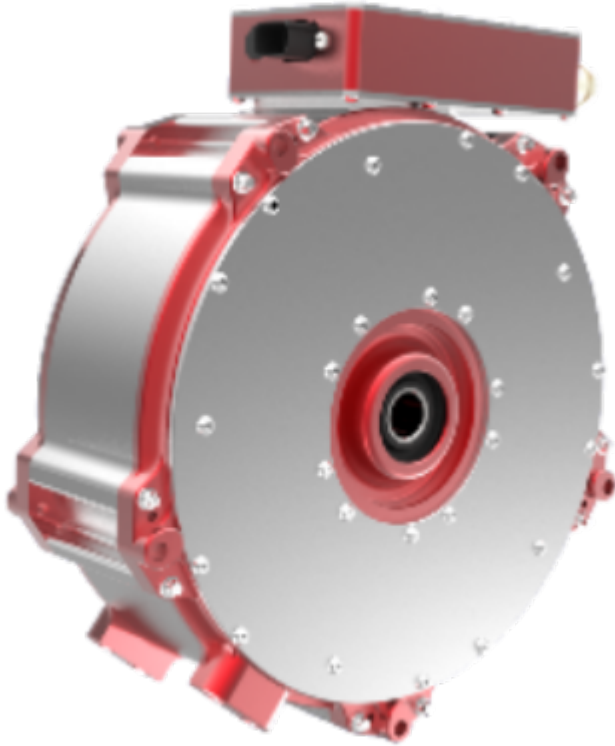


THE STORY BEHIND BEST ELECTRIC MACHINE



SYNCHRO-SYM Technologies

**– THE STORY BEHIND BEST
ELECTRIC MACHINE –**

Our Mission:

***Innovate For Our Clean, Efficient,
and Sustainable Energy Future!***

The Story Behind the Founder and CTO of Best Electric Machine, Frederick W. Klatt, And the Inventor of SYNCHRO- SYM Technologies:

After experiencing the first oil embargo in 1973, while attending the University of California, Berkeley, as an engineering post-graduate student studying nuclear magnetic resonance for medical imaging, and then, followed by the second oil embargo of 1979, I became committed to free my dependency on fossil fuel by building an electric vehicle (EV) for daily commuting. To my surprise, electric motor design and electronic-computer control design were two very disparate disciplines, which hasn't changed much since, and as a consequence, the only *readily* available EV motor at the time was the rheostat controlled, electromechanically commutated [Universal Motor](#) that was invented in the late 1800's.

Well aware of the [switch-mode power supply](#) (SMPS), which were quickly replacing the large, inefficient linear power supply in mainframe computers, I conceptually realized that electronically modulating a modified SMPS with the new microprocessor control technology would provide a much more practical, reliable, and efficient means of producing variable

frequency and voltage sinewave excitation for EV motor control. Already having a strong background in electronic and computer design (*i.e., analog, digital hardware/software design*) and electromagnetic field theory, I immersed myself in the self-study of electric machines (*i.e., electric motor, generator, and transformer*) for applying this novel control means but quickly realized that another level of motor control was needed to avoid the problematic reliance on slip-induction in accordance with the synchronous speed relation of an active winding set on the rotor and stator, respectively.

Surprisingly still being [investigated today](#), my first control concept was the doubly-fed cascaded electric slip-induction motor for the brushless propagation of speed synchronized multiphase excitation to the rotor active winding set by using the electromagnetic computation of one of the cascaded motors as a multiphase rotor winding excitation generator (**mREG**). My research and experimentation showed the dual cascaded electric induction motor method had some formidable loss, cost, size, and stability problems, such as: 1) the reliance on slip-induction (*i.e., asynchronous operation*) with receding torque angle and slip-induction at and about zero and synchronous speeds without introducing an artificial and extraordinarily inefficient means of unlike rotor and stator pole-pairs or frequency circuitry and control, 2) the brushless excitation in accordance with the synchronous speed relation, including supplying phase controlled DC at or about synchronous or zero speeds, 3) the instability by random rotor or line perturbations during synchronous operation, and 4) the opposing torque between the dual cascaded machines.

While trying to solve these problems, my eureka moment of "invention" appeared, "Simply reduce the size and mutual inductance (and associated torque) of the mREG while increasing its efficiency with a high frequency carrier design provided by a unique direct AC-to-AC synchronous modulation-demodulation method and as a result, the four imposing

problems were solved!"

After years of study, research, development, prototyping, and publication, which was debt financed through my technical consulting firm, I patented SYNCHRO-SYM, which is the only practical and stable, brushless "symmetric" multiphase wound-rotor "synchronous" doubly-fed electric machine system with the *optimal electromagnetic symmetry* of both an active rotor and universally essential active stator contributing additional working power to the electromechanical energy conversion process as only possible with a practical invention of a brushless real time emulation controller (BRTEC) for contiguously *stable* and *synchronous* operation from sub-synchronous to super-synchronous speeds, including synchronous speed and zero speeds. SYNCHRO-SYM is very different from *all other* electric machine systems with the *non-optimal electromagnetic asymmetry* of a "passive rotor" of either slip-induction dependent windings, permanent magnets, DC field windings, and reluctance saliencies with a derivative of field-oriented control for contiguously stable operation from zero speed to only synchronous speed. [Verified by nearly a century of classic electric machine 101 study, research and publication](#) in accordance with electric machine physics and a regimen of multiple progressive stages of BEM prototyping has proven that SYNCHRO-SYM with an active rotor provides twice the continuous constant torque speed (*i.e., maximum load speed or MLS*) for a given torque, port voltage and excitation frequency (*i.e., 7200 RPM with 2 poles at 60Hz versus 3600 RPM for the asymmetric electric machine system of all others*), which calculates to twice the continuous power density and octuple the peak torque at half the cost and loss per unit of continuous power rating as all others or the asymmetric electric machine system with a passive rotor in the same packaging (*less rare-earth permanent magnets*).



As an early pioneer of low and high frequency, high power *axial-flux* electric machines and real-time electromagnetic (analog) computers, who understood their benefits long before today's mantra, and to reduce the cost of contract manufacturing for prototyping and production, I conceived, researched, developed, and orchestrated successful empirical studies with several fiber laser cutters and amorphous metal companies, and then patented the only 3D Printer, called MOTORPRINTER, for the additive manufacture of axial-flux electric machines, which unlike customary 3D Printer, uses optimized, premanufactured layering feedstock materials of high performing non-crystalline (e.g., *amorphous, nanocrystalline, etc.*) metal ribbon, structural materials, and magnetic wire, which are compatible with the additively manufactured electric machine without damaging the delicate electromagnetic properties, for low-cost, inhouse prototyping and just-in-time additive manufacturing of SYNCHRO-SYMs. MOTORPRINTER is in fabrication, today.

The electromagnetic (analog) computer of BRTEC with MOTORPRINTER additive manufacture also provides unique bi-directional multiphase power conditioning, such as BMSCC, and

micro-distribution, such as BM-HFMDB.

In conclusion, I am increasingly annoyed that so-called “new” high performance electric motor system technologies of today are actually the typical asymmetric electric machine system with the simple empirical application of *available* packaging techniques or are unfairly compared with different port voltages, excitation frequencies, synchronous speed, air-gap flux density, and thermal management designs, all of which in accordance to physics, would always result in similar performance gain if equitably applied between contestants. More concerning, I am annoyed by the increasing application of RE-PM electric motor systems, which are monopolized by [a global adversary seeking world dominance](#) with exploited labor, human rights, environmental, and geopolitical violations that at the very least, is setting back years of productive climate change efforts. In response, I formed the essential lean, creative team of functional experts with a mutual urgency to prudently and ethically bootstrap the engineering, production, and sales of SYNCHRO-SYM, which is without RE-PMs but *inherently* provides double the power density and octuple the peak torque at half the cost and half the loss per unit of package continuous power rating of any other electric motor system package.
