

Hybrid EC motors - Overview

Introduction

Synchropulse has patented a new brushless electric motor concept, designed to be a more efficient and longer lasting replacement for conventional Induction, Universal and Brushed DC motors, but cheaper to produce than other high efficiency motors. It changes the cost/efficiency/compactness paradigm for sub 4kW motors, but retains a conventional construction approach; offering for the first time, a high efficiency, variable speed motor economically viable for general purpose applications.

Synchropulse motors enable significant energy savings, reducing costs and benefiting the environment.

The Market Problem

The US Department of Energy estimates 500 million motors waste 80% of the energy they consume. New European legislation is introducing mandatory efficiencies for Induction motors from 2011, with the biggest changes expected in the < 4kW sizes. It is expected that Japan will do the same. In this environment existing motor technologies are becoming less fit for purpose, especially < 4kw sizes. Motor manufacturers and OEMs need to find new high efficiency technologies that are also affordable for high volume cost sensitive markets.

The induction motor is the most common motor technology, being simple and cheap. However in smaller sizes, (especially single phase motors) they have drawbacks such as: very low efficiencies, poor starting torque and high starting current. Variable speed operation, which helps save energy, requires inconvenient external controllers. The cheaper controllers often used with smaller Induction motors reduce motor efficiency even more, negating the benefits of variable speed operation.

DC brushed or Universal motors are not suitable alternatives. The brushes generate electromagnetic interference and add cost. They also wear out over time and need replacing, introducing added maintenance or replacement costs.

The very best motors in terms of efficiency, control and longevity are Brushless or electronically commutated (EC) Permanent Magnet (PM) types and the market is moving towards these. However, these are typically multi-phase in operation and the cost of the multiphase windings and electronics, and the permanent magnet rotors makes them too expensive as replacements for induction motors for general purpose high volume applications.

The Synchropulse Solution

Synchropulse offers an adapted version of this type of brushless motor that is optimised for minimal cost so as to be a viable replacement technology for induction motors and universal motors in mainstream applications.

The Synchropulse motor is a brushless design, electronically commutated (EC), with permanent magnets (PM).

It has **high efficiencies**, as good as market leading motors in this class, and **variable speed control**.

In addition Synchropulse's patented Hybrid EC design uniquely uses a combination of both reluctance and permanent magnet (electromagnetic alignment) torque components to achieve the following advantages:

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- 1) The design enables the motor to run from a single phase electronic drive input whilst behaving like a multiphase motor. In doing this, the Synchropulse design specifically overcomes typical single-phase operating problems by ensuring the following:
 - A consistent direction of rotation whenever the motor starts
 - That torque is generated at all points, meaning the motor will always start from any point and is smooth running
 - High start-up torque, which means suitability for pump applications, unlike single phase induction motors which have weak start-up torqueThe **benefits** of achieving such effective single phase operation are:
 - Simpler windings and a reduction in the cost of the electronics by 40 – 75% compared to typical brushless motors
 - Smaller electronic controllers which can be included inside the motor, rather than in an external control unit, allowing 'plug and play' convenience.
- 2) The design requires less of the expensive magnetic material compared to other PM type motors, which reduces cost without compromising efficiency.
- 3) The design maintains the construction techniques and general physical proportions of existing motors so as to be easy to produce, and to interchange with existing Induction motors.

Synchropulse technology is ideally suited to fans, pumps, tools and general purpose applications below 4kW.

The patented Synchropulse design could be considered analogous to the generic shaded pole or split phase concepts applied to induction motors, in that it enables ECPM motors to operate in an economic single phase format. But unlike these single phase Induction motor variants, the Synchropulse motors maintain the high efficiency and versatility of the ECPM class.

Summary:

The Synchropulse patented hybrid EC technology represents a new category of motor operating principle – changing the current efficiency/cost/compactness paradigm and offering a new mix of benefits suitable for today's market requirements. Synchropulse motors:

- **Are efficient - they will pay for themselves within 12 months from reduced electricity consumption.**
- **Are easy to adopt – they can be designed to fit inside existing motor housings for easy replacement.**
- **Are cost-competitive – they minimise the use of electronics and magnets to save cost.**