Modern soft starters perform a wider range of tasks

The definition of a soft starter today is totally different to that provided even a decade ago, due, in the main, to continuing developments in power and control electronics technologies.

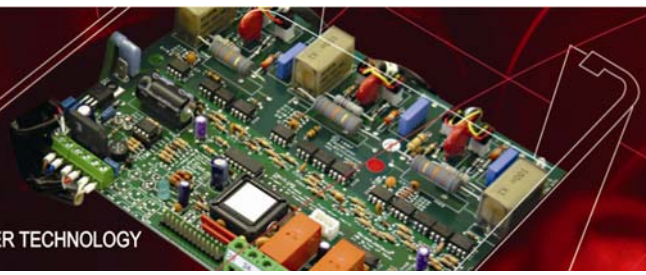
These developments are enabling soft starters to do much more than just start and stop motors softly and efficiently. They are providing the means for users to achieve energy saving, greater safeguarding of employees and equipment and also control of non-motor loads. What all this means for industry is that soft starters can be applied across a wider range of industries and applications, their traditional fit and forget reliability ensuring security of operation even in the most critical of tasks.

Features Beyond Starting and Stopping

Optimising Operation

As with a number of modern soft starters, the process of controlling the motor with Fairford's QFE and XFE models is not restricted to just starting and stopping. Once a start has been completed the motor operating efficiency becomes of interest.

When working at or near full load, the typical 3- phase induction motor is relatively efficient, readily achieving efficiencies of 85% to 95%. However, motor efficiency falls dramatically when the load falls to less than 50% of rated output. In fact, very few motors actually experience consistent fully rated operation, the vast majority operate at much lower loads due to either over-sizing (a frequent occurrence), or natural load variations as, for example, in damper and vane-controlled fan applications.



However, at light loads and mains voltages, induction motors always have excess magnetic flux which gives rise to lower efficiency and power factor. By detecting the load at any instant, and adjusting the motor terminal voltage accordingly, it is possible to save some of the excitation energy and load loss, and improve motor power factor when the motor is running inefficiently at light loads.

After a motor fitted with a Fairford QFE or XFE controller has been soft started and reached full speed, the Soft Starter indicates that it has entered the 'motor running' stage. At this point, the motor is at the full supply voltage and driving at the torque demanded by the load. Under user control, either from the keypad or through external circuitry, the Soft Starter can be selected to operate in the Fairford patented form of optimising control. While the motor is accelerating, the controller derives and stores a reference value for the motor power factor and this is continuously compared with the running power factor.

From this comparison, the software continuously computes and adjusts the firing points of the power thyristors to vary the motor flux level so that the best power factor is maintained. By reducing the over-fluxing of the motor, the power factor is maintained at the most appropriate value for every condition of load, which, in turn, reduces the reactive kVA. This will bring about a significant reduction in the kVA demand which may reduce the input kW as well.

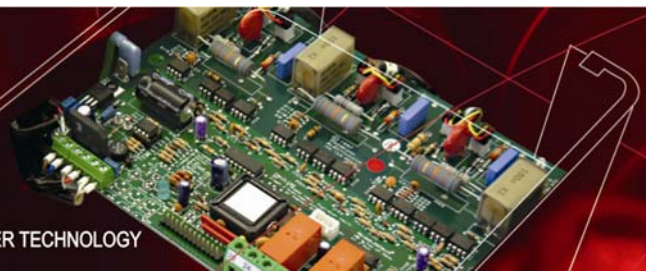
Electronic Braking

Until recently, any engineer seeking the facility for rapid stopping of a motor under emergency conditions or in situations where coast-to-stop time is lengthy, would not have chosen a soft starter.

This situation changed with the introduction of Fairford's QFE and XFE units with its capability for electronic braking. The Fairford QFE and XFE controllers include a feature that eliminates all the negative effects of plug braking, a technique that is destructive both electrically and mechanically, involving the rapid application of reverse operating power to a motor that is still partially magnetised. As a result, the QFE and XFE controllers enable motors to be stopped smoothly and without the stresses that result in longer- term motor failure.

Electronic Shear Pin

Another feature not routinely provided by soft starters, but included as standard on most of Fairford's controllers is an "Electronic Shear Pin." This facility enables the soft starter to cater for situations where loads are likely to jam suddenly, such as in wood sawing, rock crushing etc. The traditional method of achieving this protection was via a mechanical 'shear pin' that consisted of a pin of a deliberately weak material inserted into two concentric shafts at a convenient point in the drive train to the load. If the load became jammed, the sudden rise in torque would cause the pin to shear so that the two shafts could then rotate independently, thereby disconnecting the motor from its load.



Before the load could be re-started, the old pin would need to be removed and a new one inserted – an obviously inconvenient and time-consuming process. Fairford's 'Electronic Shear Pin' facility eliminates the need for a mechanical shear pin entirely because the speed and extent of a sudden and rapid rise in motor torque is immediately detected by the Soft Starter which will then decide of a course of actions ranging from instantaneous shutdown to monitoring for recurrences if the blockage is released rapidly.

Inductive Load Control

In addition to its primary role, Fairford's QFE can also control certain types of non-motor loads that contain significant inductance and which can create severe effects on a power distribution network when they are being connected to it. The most frequently encountered loads with this characteristic are large transformers. A de-energised transformer can draw an extremely heavy inrush current (up to 20 times the full-load current) if it is switched directly to a power network.

The effects of this current can be severe voltage dips, lamp flicker and the disruption of sensitive equipment. However, by regulating the energising process with a Fairford controller, these effects are eliminated and the transformer will be brought on line within its full load current.

Soft Starters 'In The Delta'

Before the advent of soft starters one of the most popular methods of starting AC induction motors was the Star Delta system. The advantage of Star Delta is that only 58% of the line voltage is applied to the motor at start-up. Because of the Square-Law relationship (see below), starting torque is reduced to just a third of locked rotor torque (LRT) with a consequent reduction in starting currents and acceleration forces. There are several drawbacks with this method, however. The arrangement is more complicated and costly using three contactors and a timing mechanism to switch between them. In addition, installation costs are greater because of the need for 6 connections between the motor and starter.

Finally, if the transfer from Star to Delta occurs at less than 80% of normal speed, large current and torque surges can arise. These drawbacks have led many companies to consider moving away from Star Delta systems, but have been deterred by the costs and lost production time involved in complete rewiring of motor starting systems. Today these costs can be avoided as Fairford's units, can be connected directly into the Delta section of the motor starter using the existing cabling.

The Square Law

The Square Law applies to all AC induction motors. It states that torque is proportional to the motor terminal voltage squared (V^2). So, for example, half the voltage produces a quarter of the torque with commensurate reductions in starting currents and acceleration forces.

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