Sensing a pulse on inrush current is key to efficient motor drive

Inventors are not shy when it comes to boasting about their inventions. So when Parker Electronics Inc., Fort Lauderdale, Fla., unveiled its energy-saving controller for induction motors, it was no surprise that the company claimed it had bettered a power-factor controller developed by the National Aeronautics and Space Administration. This invention of Frank J. Nola, at last count, had been licensed by NASA to almost 200 firms in the U. S. alone.

The surprise is, however, that the National Bureau of Standards agrees with Parker and has recommended support by the Department of Energy for the Energy Econo-

mizer, as the invention is called.

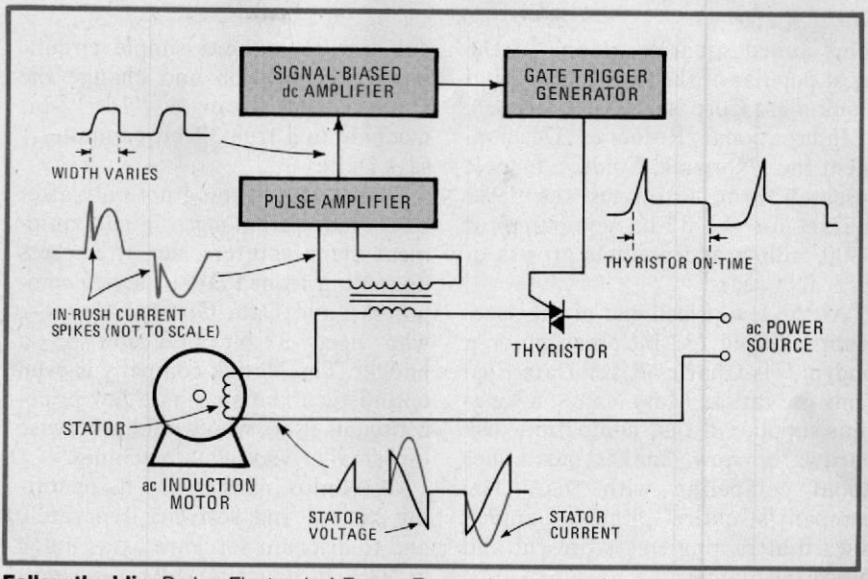
The controller, patented by Louis W. Parker and Rhey W. Hedges, was evaluated by the NBS Office of Energy-Related Inventions, Washington, D. C., under the Federal Nonnuclear Energy Research and Development Act of 1974, which provides free technical evaluations for energy-saving devices. Says Albert L. Hedrich, chief evaluator, "Parker has a better scheme for sensing motor efficiency, so NBS is recommending support to allow the Energy Economizer to enter the marketplace in competition with Nola's controller."

Less power. Hedrich notes that both inventions have the same goal: to reduce the power applied to a motor when it is operating at less than full load. Roughly 90% of the power consumed by electric motors is used in industrial applications that could benefit from such controllers. These motors turn up in machine tools, hoists, and blowers, as well as clothes dryers in the home.

Nola, to control power efficiently, developed a simple circuit that monitors the phase lag between applied voltage and stator current in the motor—an indication of motor efficiency. Both inventions use a thyristor switch to periodically interrupt, and, hence, vary, the ac power driving the motor. But Parker takes a completely different approach to sensing operating efficiency.

A stator excited by a partial sine wave, Hedges points out, experiences an inrush current with a very short characteristic pulse whose width depends inversely on the motor load. Moreover, the pulse's width, magnitude, and rise time are directly related to motor efficiency. Thus, the device relies on this pulse to tell it when to switch off the motor's power source.

The economizer monitors the inrush current for the first few hundred microseconds after the voltage is switched on. A transformer couples the pulse to an amplifier that removes the current variations due to the sinusoidal driving voltage—in effect, leaving only the inrush pulse, as shown in the figure.



Follow the blip. Parker Electronics' Energy Economizer senses the short pulse that exists on the inrush current to the stator winding and that varies with the load on the motor.

The amplifier also stretches the pulse duration to several milliseconds, maintaining the width's proportionality to motor load. A signal-biased dc amplifier converts this pulse train into a dc control voltage that controls the on-time of the thyristor switch.

Thus, for example, if the motor load drops to zero, as when the motor idles, the inrush current pulse width increases and the dc control voltage drops. This reduces the thyristor on-time and hence the power applied to the stator.

According to Hedges, who is vice president and technical director, "the phase lag between current and voltage indicates efficiency only for a full sine-wave input. When partial waves reduce the applied power, this parameter is an unreliable gauge of motor performance."

The Energy Economizer achieves nearly optimal energy savings because it directly measures the efficiency in each cycle, he says. It also avoids one of the NASA controller's early problems—instability in the control loop at low motor speeds.

However, as NASA's Nola points out, "it's hard to find a simpler design than the NASA controller. And as several companies have shown, the instability problem can be overcome." One of these firms, Nordic Controls Co. of Batavia, Ill., took Nola's device as its starting point. It then refined it to achieve what Nordic also says is nearly optimal energy savings. Nordic's units, range from a 115-volt, single-phase controller for a one-third horsepower motor at $130, to a 575-v, 50-hp controller for $1,750.

The Energy Economizer is at present under review at DOE, where Robert Bell is coordinating Government efforts. If a funding proposal is accepted, the agency could provide as much as $70,000 to $80,000 to help Parker develop and test prototypes and preproduction units. The company will then look to license the technology. **-Roderic Beresford**