



Full Overheating Protection

An innovative heating element technology uses electronic sensors to prevent appliance parts from overheating.

▶ Developed by Ferro Techniek of the Netherlands and available in North America from Davidon Industries, the technology is called E-FAST®, which stands for electronic full sensor technology. The patent-pending concept is being used in thick-film heating elements to detect electrical current generated by an overheated part of a heating track.

According to Gerd Kloppers, Ferro's development engineering manager, temperature protective devices such as bimetal switches, thermal fuses and negative temperature coefficient thermistors (NTCs) are limited in their performance by providing only local protection and delayed response. Designed as an integral part of the heating element, the sensor technology is said to offer full-area rapid response, overcoming challenges such as loss of thermal contact, delaminating and the risk of misplacing the sensor due to hot spots or thermal drift.

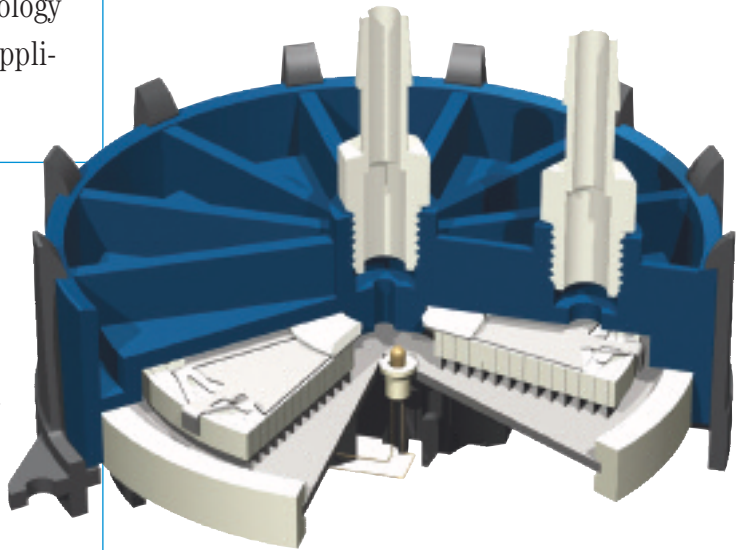
"Thick film heating elements, as we develop and produce them, are fairly recent technology," Kloppers notes. "We saw that...many applications were protected by conventional technology [such as] bimetal protectors. The problem for us was that these bimetal controllers are relatively slow and only provide local overheat detection based on where they are placed on the heating surface.

"Finding a solution for this has been a challenge for some years now," he continues. "With E-FAST, we have a protection system that fits perfectly with our heating technology and reacts as rapidly as our heaters heat up."

The technology is made up of five layers that are melted together and cannot be separated. "This makes thermal contact intimate and consistent from one element to the next," Kloppers explains.

The layers include a thick-film circuit, a low-temperature ceramic dielectric coating (Kerdi LT), the E-FAST sensor, a high-temperature ceramic dielectric coating (Kerdi HT), and carrier sheet metal. The lower dielectric layer—contained between the sensor and steel carrier—is said to have very low leakage current properties at high temperatures. The upper dielectric layer—located between the sensor and thick-film heating element track—generates a leakage current at higher temperatures. If any part of the heating element track becomes overheated, a current is generated to the sensor layer. The sensor then shuts the circuit down and stops the heating process.

"The current generated by E-FAST at normal operating temperatures is very low," Kloppers explains. "When overheating occurs, the generated current will rise exponentially with the temperature in the overheated area. When the overheated area is small, a little extra overheating will result in a detectable signal for the system as well and can be identified as a small overheat condition."



Using the properties of dielectric material, E-FAST sensor technology detects abnormal temperature variations and prevents overheating. Here, the technology is applied to a flow-through heater for the point-of-use and beverage water heating delivery. The sensor technology was designed as a safety for this module, but can be designed into any thick-film heating element application.

Also, because the upper dielectric layer is deposited close to the tracks and is thermally isolated from the steel, it can provide a quick response.

Kloppers notes that the sensor technology was originally developed for high watt density type applications using thick-film, such as Ferro's flow-through heaters, which are used in vending machines and small kitchen appliances. "The main challenge was to find the right materials...within the short development time needed to provide protection for our new instant hot flow-through heater," he says. "We have a skilled laboratory that determined and approved these materials within only a few months."

The technology can now be used in any application where high-power densities are combined with low thermal mass, especially when the heated application has an unreliable heat transport to the medium to heat. It can be applied to both grounded and non-grounded appliances, although in non-grounded appliances the carrier sheet metal and the sensor are combined into one layer.

Kloppers says one possible application is a humidifier. "Water is vaporized and will leave lots of scale on the element," he says. "This scaling up will be an unpredictable process and full-area safety protection, as E-FAST provides, will protect the elements and can even give a 'cleaning signal' to the end user."

The same benefit, he adds, is valid for steam irons, coffee makers and hot water dispensers and tea kettles. In fact, the technology is being launched in the coffee maker industry with a major customer early this year.



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