High-speed setpoint control with peak capture

The problem: controlling a heat-sealing process that takes less than 1 second.

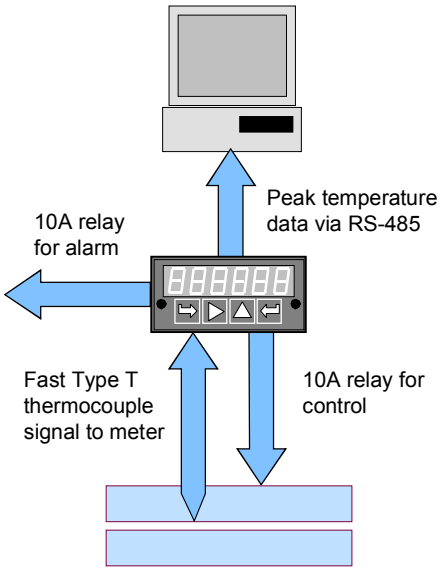
A medical manufacturer needed to find a way to control the heat sealing of plastic bags and pouches containing sterilized supplies. If the sealing equipment did not apply enough heat, a hermetic seal would not be achieved. If the equipment applied too much heat, the plastic would discolor and even melt, turning the seal into a cut.

In the sealing operation, heat is applied by passing AC current through two nichrome wires. The current causes a fast temperature rise of 100˚F/sec, allowing the heating pads to reach the desired sealing temperature of around 170˚F between 0.5 and 1 sec starting from an internal equipment temperature just above 100˚F.

Initially, the plant engineers tried to control the sealing operation by simply setting the time over which the heating current is applied. This method proved to be inadequate, since the internal temperature of the sealing equipment would rise as the equipment was being used. They then tried to turn off the heating current based on temperature measured by a variety of commercial meter relays and temperature controllers. The results were disappointing, with large temperature overshoots.

The problem was found to be the slowness of the conventional meters and controllers, which are limited to 2 ½ analog-to-digital (A/D) conversions/sec. This is far too slow to control a process with a total duration from 0.5 to 1 sec.

The plant engineers faced the further problem that they needed to document actual sealing temperatures to obtain FDA certification. The meters and controllers that they had tried were too slow to catch the peak temperatures.



Sealing equipment for medical bags

The solution: Laurel's temperature meter / controller capable of 60 conversions per second.

The plant engineers solved the problem by attaching a low-mass Type T thermocouple directly to the nichrome wires and measuring its signal with a high-speed Laurel Model L20102TF thermocouple meter / controller. This model provides an A/D conversion rate of 60/sec, dual 10A relays, peak capture with remote reset, and RS-485 I/O for data export to an external computer.

The A/D conversion rate of 60/sec is standard with all Laurel meters (DC, process, strain, TC, RTD, etc.) and is the fastest of any commercial panel meter, meter relay, or process controller on the market. Both the relay outputs and the meter's analog output track the A/D converter, allowing On/Off control and analog closed loop control of fast processes.

The application made use of the fact that all outputs of Laurel meters are electrically isolated from signal and from each other. This allowed the thermocouple to be attached directly to the AC heating wire, with no electrical isolation at the thermocouple tip. The application also made use of peak capture, which was used to record the peak temperature of every sealing cycle for transmittal to a computer via RS-485. Peak capture is highly accurate when combined with the meter's high read rate of 60/sec.

In the sealing application, the first of the two 10A relays was used to activate a time-delay relay at the exact time that the wire temperature reached a programmed setpoint, typically 170˚F. The second 10A relay was used for alarm. It was programmed for Deviation Mode Operation (see page 37 of Laurel's *Panel Instrumentation Data Book*) to flag any sealing temperatures above or below a bandpass.

Some applications of Laurel's high-speed A/D conversion

- Accurate peak capture.
- Capture of transient signals.
- Responsive setpoint control.
- Responsive 0-10V and 4-20 mA transmitter action.
- Selectable signal filtering, including unfiltered, batch average filter, and adaptive moving average filter with choice of time constants.