FLUKE®

Time and temperature

Application Note

Testing Functions **Case Study**

Tools: Fluke 724 Temperature Calibrator, Fluke 287 Digital Multimeter

Operator: Tom Paden, Integrated Control Corp. (ICC)

Measurements: RTD simulation; tracking power supply temperatures; measuring current drain per operating mode to calculate battery requirements

Cooking good food is all about the management of time and temperature. If you're a solo chef at home or in a small restaurant, you manage them yourself. Large-scale production cooking, or cooking across multiple locations, is quite different; you may need the precision and reliability of dedicated instrumentation. In that case, you might turn to the flexible, rapid-deployment systems that Tom Paden designs for Integrated Control Corp. (ICC) in Huntington, New York.

The foodservice challenge

Commercial foodservice is a demanding industry, especially in three areas. First, food safety is critical and requires strict adherence to baseline operating limits including that hot foods be kept at a minimum temperature of 140 °F, that cooked food be cooled rapidly, and that cold foods never get above 41 °F. Next, each company has its own additional requirements for food quality, including proper temperatures for ovens, holding trays and freezers. Finally, the foodservice industry has a typical profit margin of only three to five percent so high productivity is essential.

There are additional demands for a chain restaurant or a quick-service restaurant (QSR). The food has to be consistent from one location to another. Employee turnover is high, employees are often entry-level, and they may not all speak the same language. Profit margins can be even lower than in the industry as a whole, so reducing waste and inefficiency is critical. And it's extremely challenging to make a high volume of fresh, individual cooked-to-order food in minutes. The only way to do it is to have all the ingredients prepped and ready to go; that often means that some of them are partially pre-cooked and then held in warming trays, at the proper temperature and for the right length of time.

Technology can be quite useful in addressing the above challenges. There has been a kind of gap, though: refrigerator, oven and equipment manufacturers understand foodservice, but not instrumentation. On the other hand, technology OEMs and consultants do not always know how to design for ease of use by non-technical people—especially those who work in a busy environment such as foodservice. The founders of ICC wanted to build a company that bridges this gap. ICC accordingly has expertise in technology, in foodservice and in people-intensive work environments.

The ICC approach

If you ask ICC for help with your foodservice operation they'll come on site and look at your menu, workflow, and equipment. From that, they'll build a use case. The use case becomes the basis for a design that gives your staff reliable, precision control without distracting them from the customers or the food.

ICC then builds the system. Their build times are on the order of weeks so you can quickly install a system and test it in your operation. ICC systems are based on their InteMod line of integrated and modular building blocks. With InteMod, ICC can deliver systems in half the time that custom development would take, and for about a third of the cost:

- Temperature probes range: –40 °F to 125 °F, ± 0.5 °F
- Displays: numeric, alphanumeric, and bar code
- Timers
- Modems: dialup, RS-232, Ethernet
- Software: web-based. Data collection, with limit monitoring and out-of-limit notification by audible alarm plus paging and email. Daily, weekly and monthly reports, with data logged for six months

An example InteMod application is the system that ICC built for a national QSR chain. They use holding cabinets, where pre-cooked ingredients are kept ready to use. Having some ingredients partially cooked is the only way to deliver cooked-to-order food in three minutes, so holding cabinets are essential. The challenge is to not have too much food in the holding cabinets and not keep it there too long, so you have to keep track of what is in the cabinet and when it went in. That's difficult when things get busy. To make it even more difficult, a cabinet has eight slots and each can be separately programmed for food type, temperature, and holding time. Add to this any recipe changes for new products or promotions, and you have a task that demands a lot of time, attention and skill.

As part of a corporate plan to revamp its kitchens, the customer asked ICC to simplify the work of programming the holding trays. ICC conducted a use case study and designed a Product Quality Timer (PQT), built it with InteMod and delivered the first one in six weeks. The customer found it intuitive and easy to use. It had to be manually programmed though; they decided they wanted to reduce the programming task even more.

ICC then built a graphical, Palm-based application on a handheld device for programming the PQT, through a serial port. This reduced programming time from a few minutes to ten seconds, and it was deployed in kitchens that had done the Phase I revamp. For the customer's Phase II kitchens, ICC built an IR interface so the PQTs can be programmed wirelessly from the Palm devices. Program settings can even be emailed to the stores, downloaded to the Palm handheld and beamed to the PQT. With the programming time reduced to zero, the PQT solution has been rolled out to several thousand stores.

InteMod design

ICC is upgrading their InteMod line, and the engineer behind the upgrade is Tom Paden. He's going to a low-power ARM7 microprocessor, to bring InteMod from 8 bits to 32 bits. With the new processor he is putting functions like graphics and Ethernet onboard, instead of buying separate modules. He's also building new displays, bar-code capability and a label printer.

For troubleshooting InteMod, Tom uses a Fluke 724 Temperature Calibrator and a Fluke Digital Multimeter; he has just upgraded his DMM from a model 77 to a model 287.

- He used the DMM to characterize power usage in the wireless temperature probe so he could specify the right battery. The probe uses coin-cell lithium batteries, which come in various capacities; Tom needed to choose one with an adequate operating lifetime. With the DMM, he measured the current drain in each of the probe's six operating modes: sleep, wake (100 ms every 10 seconds), battery-level detector on (one of the firmware's first tasks on waking is to verify that the battery has enough charge), read the temperature sensor, transmit a binary 0, transmit a binary 1. Tom then calculated the battery capacity requirement by putting all the measured values into a spreadsheet along with time estimates for each mode.
- The Fluke 724 helped him determine the capacity of InteMod power supplies for a customer who wanted to use a new configuration of timer/display bars, leading to something higher than the standard load. The bars have a lot of LEDs, with a total voltage drop of about 0.1 V. Tom's primary concern was the corresponding temperature rise in the power supply's switching IC. He used one input on the 724 to make sure the timer bar voltage stayed high enough and used the other input to watch the switching IC's temperature rise: it was 40 °C above ambient. Tom wants the junction in the switching IC to stay at 120 °C or below, so the ambient temperature could be up to 80 °C—far above the room temperature in any likely environment—and he could tell the customer that the power supply would indeed support the new timer bar configuration.
- Tom is also using the 724 to help him design an extension probe for ICC's TempMinder module. TempMinder is an integrated unit consisting of an IC for measuring temperature and a wireless transmitter. It doesn't do everything Tom wants, though: it only reads up to 150 °C and cannot be immersed. His new probe has a resistance temperature detector (RTD) in a stainless-steel sheath, with a cable connection to TempMinder. The probe's range is –40 °C to +200 °C, it can be immersed (in fry baths, for example), and it can be wired into a freezer or other enclosure whose metal walls would block TempMinder's wireless transmissions. To verify his design, he uses the RTD simulation function on the 724; he just dials in a temperature and the 724 provides the corresponding level of resistance to his prototype. As Tom says, it's a lot easier to simulate an RTD with the 724 than to set up a bunch of temperature-controlled baths.

With the upgraded InteMod line, ICC can expect to continue building powerful systems for applications in foodservice and other people-intensive environments. That means that more and more people, when they eat in a quick-service restaurant or get food to go, may have Tom Paden to thank for making sure their food is fresh, hot and cooked right.

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