INSIGHT INTO YOUR THERMAL PROCESS UNITS ANYTIME, ANYWHERE.

Monitoring and control in the palm of your hand

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BACKGROUND

Heat-treaters don't need to be left out in the cold anymore. Whether it is a quench furnace, cupellation furnace, atmosphere box furnace, an industrial walk-in oven, or a laboratory temperature chamber, monitoring the control is usually performed locally by an operator. And certainly, that has its place. But when a thermal process unit is found to perform poorly, what is an operator to do when production schedules need to be met, customers need to be satisfied, and management needs to keep running a smooth and profitable business?

Well, the operator may try brute force, simply working around a poor performing unit, use trial-and-error approaches to get the unit running well again, or when all else fails, call the maintenance technician for assistance. Of course, by that time, usually the situation has worsened, time is of the essence, and the maintenance technician is likely off somewhere else fighting some other fire, pun obviously intended.

By this time, the maintenance technician has too little background into the problem and too little time to resolve it. There may or may not be recent history to reference, the operators may or may not recall exactly what they have already tried to get the unit running well again, and the needed documentation is likely collecting dust on a shelf somewhere, if it exists at all. Spare parts for the unit may or may not be readily available. And yet, the clock is ticking to get the problem resolved and get the unit back in production.

Some facilities may have invested in a local data acquisition system connected to the controllers on the thermal unit and this may provide additional data to help analyze the problem. Well, that is, as long as there is someone at the plant to keep that PC system itself current and running properly. Whether it's keeping up with operating system updates, security patches, database updates, HMI screens, trend history files, or periodic backups, these systems need care and attention. Who does this at the plant? Is it their main job or a hobby? What else could this person be doing at the plant if not burdened with this upkeep? And what happens in a few years when either the PC gets bogged down or it's time for the next version of the PC's operating system? And, let's face it, some plant managers simply cannot afford the initial costs and the subsequent maintenance costs of such a system.

So what is the alternative? The answer is analogous to what many people have in their homes today. If I can monitor the temperature in my house, essentially anytime and from anywhere in the world simply by using my smartphone, why can't I monitor a thermal process unit in an industrial plant? Well, the answer is, of course we can. And many of the benefits come from some very basic insights. Let's touch on a few:

- Current temperature, set point, and deviation
- Current mode of operation
- Alarm conditions
- Trend history
- Controller health

TEMPERATURE, SET POINT, AND DEVIATION

> **Just like remotely monitoring your thermostat at home, being able to check the current temperatures, set points, and deviations between them for a thermal chamber provides the most basic yet most useful information for a thermal process unit.**

Having the ability to get notified about unusual and unexpected conditions in these most basic pieces of data can help avoid or greatly reduce unexpected downtime. We'll cover this more under alarm conditions.

But before we move on to alarms, let's stay here in the moment. Just like your house may have multiple thermostats, a thermal process unit may have multiple temperature controllers. An industrial multi-zone glass furnace is an example of this. When one first looks remotely at an industrial thermal chamber, furnace, or oven, it would help to initially get an overall health of the thermal unit, spanning all the controllers on that unit. If you're remotely taking a peek at a chamber while at your child's sporting event or school play, why get diverted for any more time then needed? If, within one quick glance, you can see that the unit is working well across all its controllers, put that smartphone right back in your pocket. Figure 1 shows an example of a simple screen on a mobile phone that gives a high-level summary of a thermal chamber, including composite status from multiple controllers on that chamber.

Of course, once we get an overall status of a thermal chamber, we may want to drill down into successive levels of detail on a specific controller on that chamber. Figure 2 shows an example of a simple single zone thermal chamber consisting of one temperature controller and one high limit controller. Figure 3 shows the next level of detail on one of the controllers.

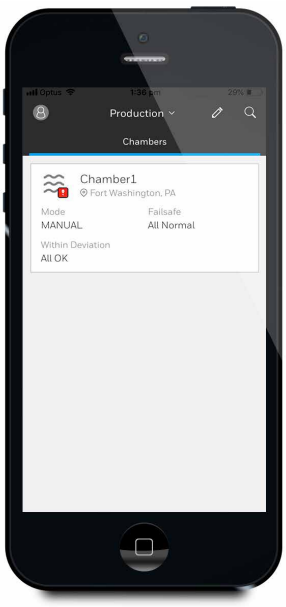

Figure 1 – Thermal Unit Summary

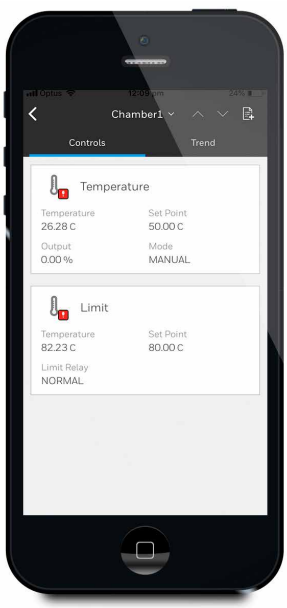

Figure 2 – Control Summary of all controllers on a thermal chamber

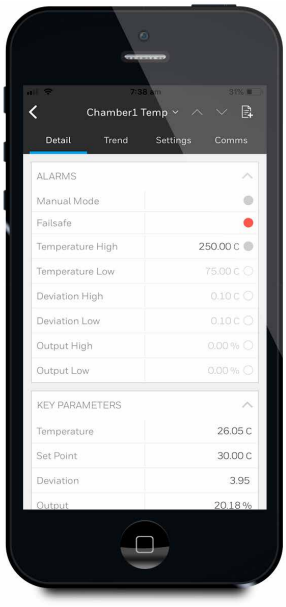

Figure 3 – Detail Screen for a controller

OPERATING MODE

Controllers can run in one of two modes: Automatic mode, where the controller uses the configured parameters that determine how and when to apply a control output to the process without operator intervention or Manual mode, where the operator overrides the Automatic mode and applies control as he/she see fit. Consider the analogy of cruise control on an automobile. When cruise control is selected, the operator, the driver in this case, turns over control of the speed to the car's controller. Cruise control maintains the speed "set point" as selected by the driver. And just as there are times for the driver to take over manual control of the car's speed, there are times when the operator takes control of the thermal process unit by changing the controller to Manual mode.

But here is the key difference – cruise control is usually off and the driver has manual control of the automobile's speed. Manual operation of the automobile is still seen to be the default. But thermal process units are better operated in Automatic mode. If that were not the case, why have controllers on the thermal units at all?

Thermal chambers operating in Automatic mode more accurately control the temperature, minimizing the deviation between the actual temperature and the desired set point. This results in higher quality in the product under temperature. Energy consumption is reduced with controllers in Automatic mode and which have been properly tuned. Finally, heating and cooling elements are better utilized and less prone to early wear-and-tear when the controllers are operating in Automatic mode.

ALARM CONDITIONS

Sir Edward Coke, a 17th-century English barrister, judge, and politician once said, "Precaution is better than cure." One might assume that Coke would have been a fan of preventive maintenance and even more excited about the tools offered with predictive maintenance. Coke seemed to appreciate that early warning indicators would lead one to act and behave with precaution rather than the more arduous pursuit of a cure.

Alarms, when used to provide early warning indicators to important process or equipment conditions, allow plant personnel to either act sooner or, at least, establish a corrective action plan before they are under duress and business in significantly impacted.

Most thermal process units, including the controllers installed with them, provide conditions to be monitored and alarms to be generated. If there are personnel in the area, they may see a visual signal like a panel light or a beacon, or they may hear an audible alert like a horn. But what if there is no one present to see or hear the alert? Or what of that annunciator itself failed? If nothing else, what backup method is available to alert plant personnel that a condition at a unit needs attention?

Why can't one receive a notification on their smartphone when an alarm condition at a thermal process unit occurs? Many people receive other alerts on their phone: weather alerts, traffic alerts, home security alerts, among them. So, of course, the technology surely exists to notify plant personnel of alarm conditions from a thermal chamber. Figure 4 illustrates an example of alarm notifications pushed to a smartphone to indicate conditions warranting attention.

But what conditions should result in alarms for a thermal chamber? And how should they relate to any local alarm conditions configured within the controllers? One could start with simply emulating the alarms at the controller. But most controllers have limited alarming capability due to the nature of the device itself and their alarm output options. Or one could expand the alarming for remote monitoring purposes, taking best advantage of the compute resources and the better user experience offered from a smartphone or tablet. Figure 5 shows an example of alarm settings for a remote monitoring package geared toward industrial thermal chambers.

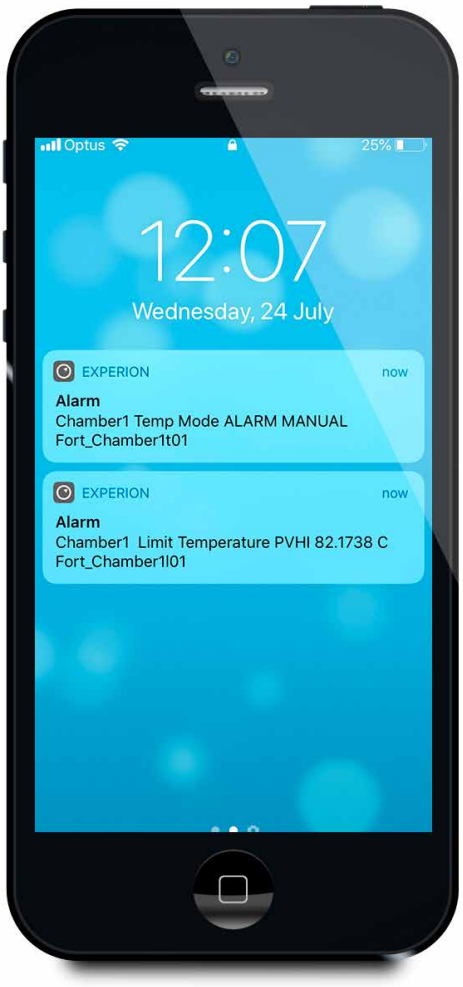

Figure 4 – Alarm notifications pushed to phone

Providing alarms, selectable by the user, for high/low temperatures, high/low deviation from set point, and high/low controller output levels provides the essential conditions while keeping the application simple to understand and easy to use. Add to this alarm options for change to Manual mode as well as state change from normal operating conditions to failsafe give the remote user visibility to more unusual conditions at the thermal process unit.

TREND HISTORY

Collecting and analyzing patterns over time is as old as humankind itself. And using patterns from the past to help understand the present or future has been used in many different aspects of our lives and our businesses. And using smartphones and tablets to access and track data over a time period is so common, we are using this technology to track our personal health, our finances, and the weather, among them. So why can't we see time-based trends in the performance of thermal process units from anywhere and at anytime using our mobile devices? Well, of course we can. The technology is available. All that is needed really is for us to value this as we do the myriad of data we use in like manner in our personal life.

Figure 6 shows an example of a simple trend screen on a mobile phone for a thermal chamber. Simply collecting and trending the basics of temperature, set point, and output can give us both a quick assessment of the chamber's operation, as well as insight into potential inefficiencies, control actions, and sensor health.

While many thermal processing units may include a recorder to capture data over time, it may not be as readily available to a remote mobile device user and it may not put the controllers' other data in context as shown and described in Figure 1. And for thermal process units without dedicated recorders, collecting the data directly from the controller in support of presenting it on a mobile device application can be more cost-effective.

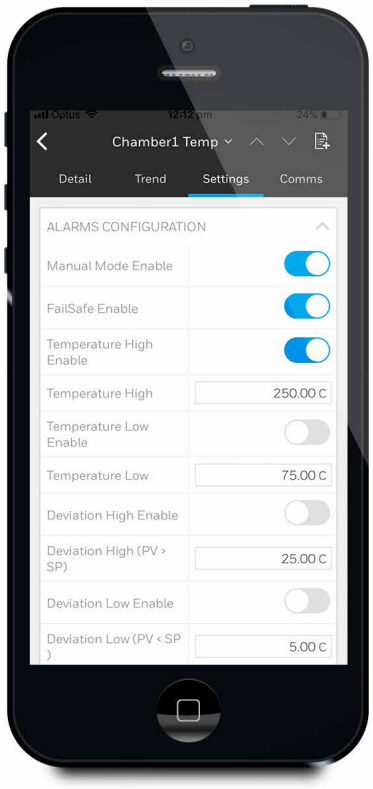

Figure 5 – Alarm Configuration for Temperature Controller

CONTROLLER HEALTH

Most digital temperature controllers perform background diagnostics as to their own health. For an operator at the thermal chamber, these conditions can be observed at the local display of the controller itself. The remote user should also have access to these conditions. We have already mentioned one such condition, failsafe, where a controller is configured to drive its output to a safe state or value based on the detection of internal conditions of the controller. Additional internal checks related to the controller health are often simply reported as a general hardware fault.

The purpose of informing a remote user of controller health conditions is to provide the maintenance technician with an alert that the controller requires attention. Often, the operator may not notice or know how to respond to a condition posted at the local display. Providing this insight to the technician and the supervisor allows them to backstop their operators and get an issue resolved before is causes a significant disruption to the plant.

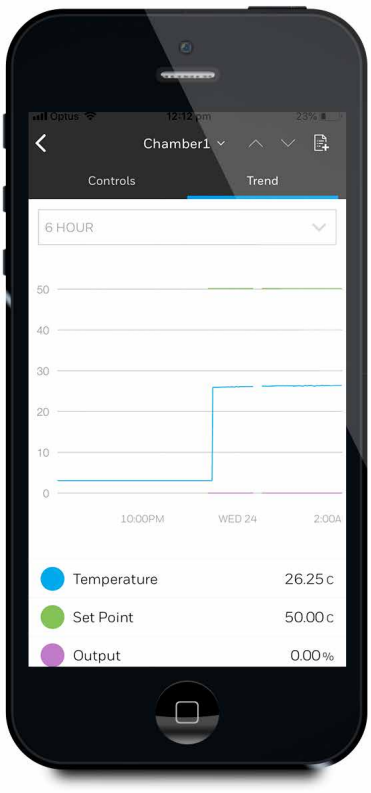

Figure 6 - Trending

HOW DOES THIS WORK?

Where is this data? How does it get to your smartphone or tablet? Who can see your data? Let's address these questions.

The source of the temperature measurements, set points, control outputs, operating modes, and controller health start in the controller itself. Figure 7 shows a single loop temperature controller from Honeywell, the UDC 2500.

Connecting the controllers to an edge communication device can be simple if the supplier provides it preconfigured and tested before it's shipped. Figure 8 is an example of a cellular modem from Honeywell that comes ready to go out of the box.

The edge device connects to the controllers typically using either serial RS-485 or Ethernet, depending on what both the edge device and the controller support. To relieve the plant personnel of installation and continued maintenance of an on-premise monitoring system, the data collection software runs remotely and is maintained by the supplier, usually on a subscription basis. Look for an offering that lets you start small and economically and grow as you can afford.

The data collection software communicates to a mobile application on your smartphone or tablet. That's how the alarm notifications get pushed to your phone, raising your attention to a condition, and from there, use the app's screens to drill down to get more information and more insight into your operations. Look for an offering that supports both iOS and Android devices.

Figure 7 – Single Loop Temperature Controller

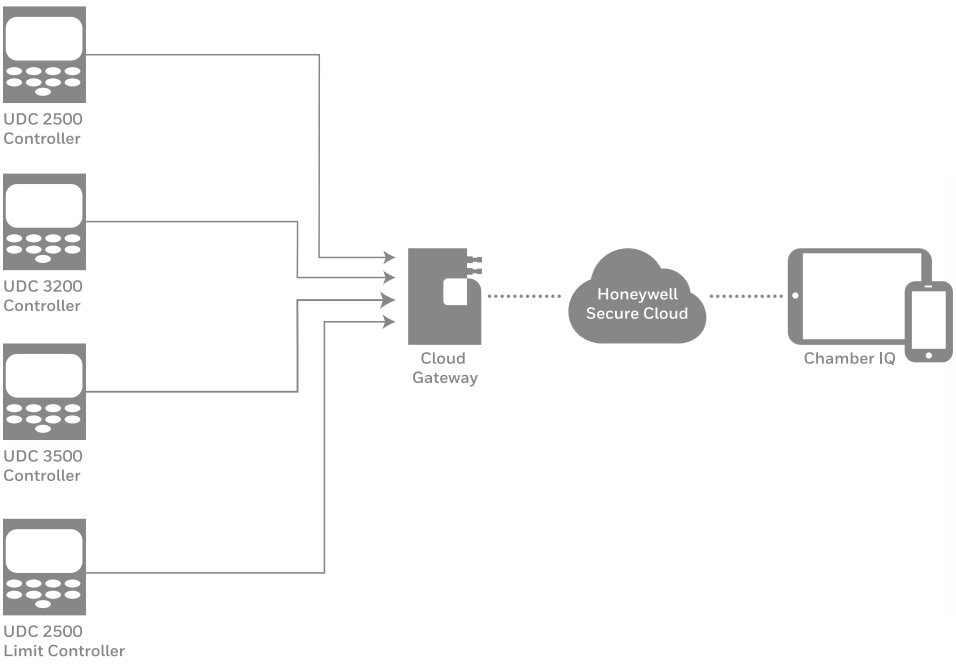

Figure 8 – Preconfigured Cellular Modem

WHAT ELSE CAN THERE POSSIBLY BE?

Look ahead to part two where we'll explore what else can be done with the data beyond monitoring, trending, and alarming. We'll present some simple yet effective data analytics that can be offered on top of the collection and monitoring. And we'll touch on some additional use cases for maintenance technicians, plant supervisors, and others that are involved in the business aspects where thermal process units are an important part of running a safe and smooth operations.

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