CPC400 Multi-Loop Temperature Controller with TRU-TUNE+™ Adaptive Control

Does the TRU-TUNE+™ algorithm tune at set point?
Yes, the TRU-TUNE+™ algorithm performs its tune at set point. However, it is possible to begin tuning while ramping to set point and doing so will shorten the time to optimize a process.

Does adaptive tuning disturb the process?
No, unlike some other tuning methods, TRU-TUNE+™ adaptive control does not introduce disturbances in to the process to determine how the process reacts. TRU-TUNE+™ continuously monitors the actual process performance and adjusts the tuning as needed.

How long does the TRU-TUNE+™ adaptive algorithm take to optimize my process?
Some processes will tune in as little three minutes. You can expect TRU-TUNE+™ to have completely optimized a fast process in about 30 minutes. A slow process may take an hour or two. Typically, you can begin using the controller once the process variable reaches set point and may not even notice that the TRU-TUNE+™ algorithm continues to optimize the process for some time after that.

Has the TRU-TUNE+™ adaptive algorithm been deployed in any applications?
Over the past two years Watlow has developed a suite of new tools to measure and characterize good control and tuning. These tools include computerized loads and control simulations that have been verified against actual physical systems. Exhaustive testing with these tools has demonstrated a broad range of applicability for the TRU-TUNE+™ algorithm. The CPC400 with the TRU-TUNE+™ algorithm has also been tested successfully and sold to a customer for whom competing products have failed. See the case history regarding decontamination trailers. The sales agent on the project said, "I've tuned hundreds of systems and I've never seen an algorithm control as well as this one."

Will I be able to use this feature to tune a process without calling in an expert?
Yes, this is the strong point of the TRU-TUNE+™ adaptive control algorithm. It is ideal for tuning loops where a tuning expert is unavailable because it applies built-in expertise automatically. All the operator has to do is set up the sensor type and output type (time proportioning, burst fire/DZC etc.), set a set point and set the control mode to *tune*. After that the TRU-TUNE+™ control algorithm takes charge.

Is the TRU-TUNE+™ algorithm only for people who need adaptive tuning?
No. We know from our experience providing Watlow controllers with auto-tuning, most applications are not so dynamic that they require adaptive tuning, but virtually any process could be better tuned, and that is where TRU-TUNE+™ adaptive control comes in. The TRU-TUNE+™ adaptive algorithm tunes a process to a higher degree of precision than a normal auto-tune function. That means that the resulting PID settings (proportional band, integral/reset and derivative/rate) will better reflect the thermal characteristics of the process.

What is the benefit of better tuning?
When a process is well tuned, processed materials are kept closer to the target temperature, and that improves yield and reduces scrap and rework of mis-processed material. Also, when the process variable tracks the set point better, the process spends less time warming up and stabilizing so it is available and productive more of the time which can help save on capital and energy costs.

How do I know if my process needs adaptive tuning?

The TRU-TUNE+™ adaptive control algorithm can help improve tuning in virtually any process because it replaces the requirement for the customer to be a tuning expert or contract a tuning expert. Some processes, however, cannot be feasibly tuned even by an expert because they require re-tuning as conditions change. This is true for processes that are operated at a very wide range of set points such that the PID parameter values need to be different at different set points. It is also true for processes that routinely undergo load changes such as an exothermic chemical reaction or shear heat that results from a plastic extrusion process. For such processes Watlow's adaptive control will provide a better match of PID parameters that are automatically optimized.

Is adaptive tuning always better than auto-tuning?

In a batch process, such as an oven where the temperature cycles as parts are loaded and unloaded, you may not want the controller to tune all the time. In that case use the TRU-TUNE+ feature to tune the controller at the oven's operating temperature and then switch the control to automatic to prevent de-tuning during load and unload operations.

Will TRU-TUNE+™ "over-tune" my process?

No, the TRU-TUNE+™ adaptive algorithm is specifically designed to adjust the tuning only when the process is not optimized. Once the PID parameters are adjusted to the optimum values the TRU-TUNE+™ algorithm stops making adjustments until external conditions change such that the tuning needs to be adjusted.

If the tune band is set too small will this cause the process variable to hunt around set point?

The tune band parameter prevents the controller from de-tuning the control parameters when the process variable is too far from the set point. By default the tune band is set automatically by the TRU-TUNE+ algorithm and that is the recommended setting for nearly all applications. On a very fast process if the user has set the tune band too small, the process may oscillate, depending on the initial PID settings because the adaptive algorithm will not have time to adjust the control parameters between the process variable excursions from the tune band. In that case you should increase the tune band setting.

Is the tune band asymmetrically adjustable about the set point?

By default TRU-TUNE+™ automatically adjusts the tune band appropriately for heating, cooling or both. It is recommended that the user leave the tune band parameter set to automatic. In the event the tune band is manually set, it is symmetric about set point.

Is there a relationship between proportional band and tune band?

No, the tune band and proportional band are not directly related. Both the tune band and proportional band are automatically set by the TRU-TUNE+™ adaptive algorithm. If the user adjusts the proportional band manually, there is no effect on the tune band. If the user adjusts the tune band manually, it may affect how TRU-TUNE+ sets the proportional band in the future.

If I start up a system with the controller in the adaptive mode, will the controller cause the process variable to oscillate around a tuning set point below the actual set point before attempting to control at my set point?

No, TRU-TUNE+™ does not disturb the system or keep the process variable from reaching set point in order to tune. It is recommended to perform an auto-tune first and allow the controller to continue controlling at set point in the adaptive mode at least until the PID parameters are completely tuned.

Does this controller use an adjustable rate band for overshoot reduction?

No, TRU-TUNE+™ does not use the derivative or rate function to reduce overshoot. The TRU-TUNE+™ algorithm's overshoot reduction feature allows the PID parameters to be optimized for control without having to compromise tuning to prevent overshoot.

Should I set overshoot reduction prior to auto-tuning on initial start up (especially for sensitive systems that won't tolerate overshoot)?
By default overshoot reduction is set to 50% in the CPC400. Setting the overshoot reduction parameter to 100% minimizes overshoot. You can adjust the overshoot reduction at any time. It will not interfere with the TRU-TUNE+™ adaptive algorithm's ability to tune the system.

Can the new parameters, Adaptive Control Mode, Tune Band, Tune Gain and Overshoot Reduction, be tied to the logic capability of the CPC400?
Yes, all the new parameters and settings are accessible to logic programs created with LOGICPRO software.

Under what versions of Windows® can I run LOGICPRO?
The optional logic programming software for the CPC400, LOGICPRO, runs under Windows 95®, Windows 98® Second Edition, Windows ME®, Windows NT® and Windows 2000®. It does not run under Windows XP®

When will TRU-TUNE+™ be available other Watlow controllers?
Watlow is planning to incorporate the TRU-TUNE+™ adaptive control algorithm into additional products in the coming months.

Does WATVIEW HMI software support TRU-TUNE+™?
WATVIEW will work with this latest revision of the CPC400, but the new TRU-TUNE+™ parameters will not appear. You can set all the other settings in the controller and monitor the temperatures and alarms, but you will have to select the new adaptive control mode through the controller's front panel. The next revision of WATVIEW currently planned for late 2005 is slated to support the additional parameters available in the revised CPC400 firmware.