

Ziegler-Nichols Loop Tuning

The Ziegler-Nichols loop tuning protocol¹⁾ is a simple method to establishing the loop parameter values for a PI or PID control loop. This protocol is designed to optimize the loop for disturbance rejection.

Links

- Click here for the [SLICE-QTC Manual](#).
- Click here for the [SLICE-QTC Quick Start Guide](#).
- Click here for the [SLICE-QTC API](#).
- Click here for the [SLICE-QTC web page](#).
- Click here for the [Github page for SLICE-QTC GUI](#).
- Click here for the [Github page for SLICE-QTC firmware revisions](#).
- Click here for a [Video Tutorial](#).



Instructions




There is the possibility for the loop to go unstable at too high gain. Use caution as gain is increased.

1. From the Home Screen, touch the Channel icon for the loop to be tuned
2. Touch Settings > PID Params
3. Choose a Set Point temperature
4. Set Proportional Gain (K_p) to 0
5. Turn off Integral and Differential portions of the loop (T_i & T_d , respectively)
6. While monitoring the error in temperature on rolling graph on the SLICE-QTC display or an [external oscilloscope](#), **slowly** increase ($\sim 10\%$ per increment) K_p until the error begins to oscillate




7. Use the  and  icons, to scale displayed response appropriately



8. Use the  icon to pause the graph
 1. Note: the pause icon only pauses the graph, not the servo control
9. Note K_p where oscillations of increasing amplitude begin; this is $K_{p,cr}$, the critical proportional gain.



10. Use the Cursors enabled by touching the  icon to measure the period of oscillation, T_{cr}
 1. You can use the two rotary knobs or touch & drag the cursors on the touch screen
11. Use the following table to set the values of K_p , T_i , and T_d

Type of Control Loop	K_p	T_i	T_d
PI	$0.45 \cdot K_{p,cr}$	$0.83 \cdot T_{cr}$	0

PID	$0.6 \cdot K_{p, cr}$	$0.5 \cdot T_{cr}$	$0.125 \cdot T_{cr}$
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Tab. 1: Ziegler-Nichols loop values

1)

Optimum Settings for Automatic Controllers, by J.G. Zieger and N. B. Nichols and Wikipedia

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